EPA/ROD/R03-99/010
1999

EPA Superfund
Record of Decision:

NAVAL WEAPONS STATION - YORKTOWN
EPA ID: VA8170024170
OU 06
YORKTOWN, VA
06/09/1999

Final

Record of Decision

Operable Unit Nos. VIII and IX
Site 1 - Dudley Road Landfill
and
Site 3 - Group 16 Magazines Landfill

Naval Weapons Station Yorktown
Yorktown, Virginia

May 1999

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CRP	Community Relations Program
CT	central tendency
DoD	Department of Defense
DoN	Department of the Navy
ESQD	explosive safety quantity distance
FFA	Federal Facility Agreement
FS	Feasibility Study
HI	hazard index
HQ	hazard quotient
IAS	Initial Assessment Study
ICR	incremental cancer risk
IDW	investigation derived waste
IR	Installation Restoration
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
LOAEL	Lowest Observed Adverse Effect Level
LUC	land use control
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	No Observable Adverse Effect Level
NPL	National Priorities List
NPW	net present worth

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

O&M	operation and maintenance
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PRAP	Proposed Remedial Action Plan
RA	risk assessment
RAA	remedial action alternative
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	reasonable maximum exposure
RIL	remediation level
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
TBC	to-be-considered criterion
TNT	trinitrotoluene
UCL	upper confidence level
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WPNSTA	Naval Weapons Station

1.0 DECLARATION OF THE RECORD OF DECISION

1.1 Site Name and Location

Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia Sites 1 and 3; Operable Units (OUs) VIII and IX

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) documents the selected remedial actions to reduce the risks posed by soil at Site 1 and soil at Site 3 located at WPNSTA Yorktown. Yorktown, Virginia. Soil contaminated by arsenic at Site 1 is designated as OU VIII and soil contaminated by polynuclear aromatic hydrocarbons (PAHs) at Site 3 is designated as OU IX The remedial actions are chosen in accordance with the Comprehensive Environmental Response. Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and. to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (NLCP). The information supporting the decisions on the selected remedies is contained in the administrative record file. Section 2.2.2 lists major documents contained in the administrative record file.

The Commonwealth of Virginia concurs with the selected remedy.

1.3 Assessment of the Sites

Actual or threatened releases of hazardous substances from OUs VIII and IX, if not addressed by implementing the remedial actions selected in this ROD, may present an imminent and substantial endangerment to human health and the environment.

1.4 Description of the Selected Remedies

The cleanup of OU VIII and OU IX is part of a comprehensive environmental remediation currently being performed at WPNSTA Yorktown under the Department of Defense (DoD) Installation Restoration (1R) Program.

The removal of soil at Sites 1 and 3 addresses the principal threat to human health and the environment at OUs VIII and IX by eliminating the source materials (arsenic and polynuclear aromatic hydrocarbons (PAHs)) and eliminating the potential release of these contaminants to the environment. Major components of the selected remedies for OUs VIII and IX include:

OU VIII - Site 1 - Dudley Road Landfill

- Removing and disposing/recycling surficial debris identified at Site 1.

- Excavating the soil in the southwest portion of Site 1 (near monitoring wells 1GW12A and 1GW12B) which exceeds arsenic concentrations or 63 milligrams per kilogram (mg/kg). The depth of the excavation will be approximately two feet. Confirmatory soil samples will be collected to confirm the extent of contamination.

- Disposing of the arsenic-contaminated soil at an off-site approved disposal facility.

- Backfilling the excavation area with clean soil fill from the WPNSTA borrow pit.

- Restoring portions of the existing soil cover at Site 1. This will include backfilling the depressions and eroded areas of the soil cover with clean soil fill from the WPNSTA borrow pit, and then placing topsoil over the disturbed areas, including the backfilled excavation area. The areas will then be revegetated with native grasses.

- Current land use controls exist for Site 1 because of the Explosive Safety Quantity Distance (ESQD) arc associated with the storage of ordnance, which prohibits residential development and certain types of industrial development. Land use controls will be included in the WPNSTA Land Use Control Assurance Plan (LUCAP) independent of the land use controls associated with the ESQD arc. The additional restriction will prohibit future residential property use because soil will be remediated to meet commercial/industrial levels, the most likely future land use scenario, and contaminant concentrations exceeding residential remediation levels will remain in soil at Site 1.

OU IX - Site 3 - Group 16 Magazines Landfill

- Removing and disposing/recycling surficial debris identified at Site

- Excavating the soil in the northeast portion of Site 3 (near soil sample location 3SS10), which exceeds PAH (total carcinogenic) concentrations of 10 mg/kg. The depth of the excavation will be approximately two feet. Confirmatory soil samples will be collected to confirm the extent of contamination.

- Disposing of the PAH-contaminated soil at an off-site approved disposal facility.

- Backfilling the excavation area with clean soil fill from the WPNSTA borrow pit.

- Placing six inches of topsoil over the excavation area, and then revegetating this area with native grasses.

- Current land use controls exist for Site 3 because of the Explosive Safety Quantity Distance (ESQD) arc associated with the storage of ordnance, which prohibits residential development and certain types of industrial development. Land use controls will be included in the WPNSTA LUCAP independent of the land use controls associated with the ESQD arc. The additional restriction will prohibit future residential property use because soil will be remediated to meet commercial/industrial levels, the most likely future land use scenario, and contaminant concentrations exceeding residential remediation levels will remain in soil at Site 3.

1.5 Statutory Determinations

The selected remedies are protective of human health and the environment, comply with Federal and State (Commonwealth) requirements that are legally applicable or relevant and appropriate requirements (ARARs) to the remedial action, and are cost-effective. The remedies use permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedies do not meet the statutory preference for remedies employing treatment which permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants as a principal element. The selected remedies, which include excavation and off-site disposal of contaminated soil, represent a better balance of tradeoffs under the evaluation criteria than alternatives using treatment, due to the limited volume of soil requiring remediation at both sites. Because the remedies will result in hazardous substances remaining on-site, a review will be conducted no less often than every five years after the initiation of the remedial actions to ensure the remedies continue to provide protection of human health and the environment.

7 Jun 99

J. R. Doyle, CAPT, CEC, USN
Regional Engineer
By direction of the Commander,
Navy Region Mid-Atlantic

Date

6/9/99

Abraham Ferdas, Director
Hazardous Site Cleanup Division
United States Environmental Protection Agency, Region III

Date

2.0 DECISION SUMMARY

2.1 Site Name, Location, and Description

WPNSTA Yorktown is a 10,624 acre installation on the Virginia Peninsula in York and James City Counties and the City of Newport News (**Figure 2-1**). It is bounded on the northwest by the Naval Supply Center Cheatham Annex, the Virginia Emergency Fuel Farm, and the future community development of Whittaker's Mill; on the northeast by the York River and the Colonial National Historic Parkway; on the southwest by Route 143 and Interstate 64; and on the southeast by Route 238 and the community of Lackey.

2.1.1 Site 1 - Dudley Road Landfill

Site 1 (**Figure 2-2**) is an approximately 6-acre area located just north of the headwaters of Indian Field Creek. A dirt road runs through the site and a dirt mound is located in the northern portion of the site. The majority of the area is cleared, but is surrounded by woods. Site 1 is named for its proximity to Dudley Road.

The general topography at Site 1 is level (near the landfill) with a slight slope to the east and more pronounced slopes east and south of the site toward Indian Field Creek. Thus, the majority of surface water drains toward Indian Field Creek.

2.1.2 Site 3 - Group 16 Magazines Landfill

Site 3 (**Figure 2-2**) is a 2-acre area located east of the Group 16 Magazines and south of Site 1. Site 3 is separated from Site 1 by a ravine leading to Indian Field Creek. Site 3 is named for its proximity to the Group 16 Magazines.

The general topography at Site 3 can be described as uneven with topographic highs at the northern and southwestern areas of the site, and topographic lows (excluding the areas adjacent to Indian Field Creek) within the landfill. Surface water across the site flows in the direction of Indian Field Creek.

2.2 Site History and Enforcement Activities

2.2.1 Site History

Originally named the U.S. Mine Depot, WPNSTA Yorktown was established in 1918 to support the laying of mines in the North Sea during World War I. For 20 years after World War I, the depot received, reclaimed, stored, and issued mines, depth charges, and related materials. During World War II, the facility was expanded to include three additional trinitrotoluene (TNT) loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944. In 1947, a quality evaluation laboratory was developed to monitor

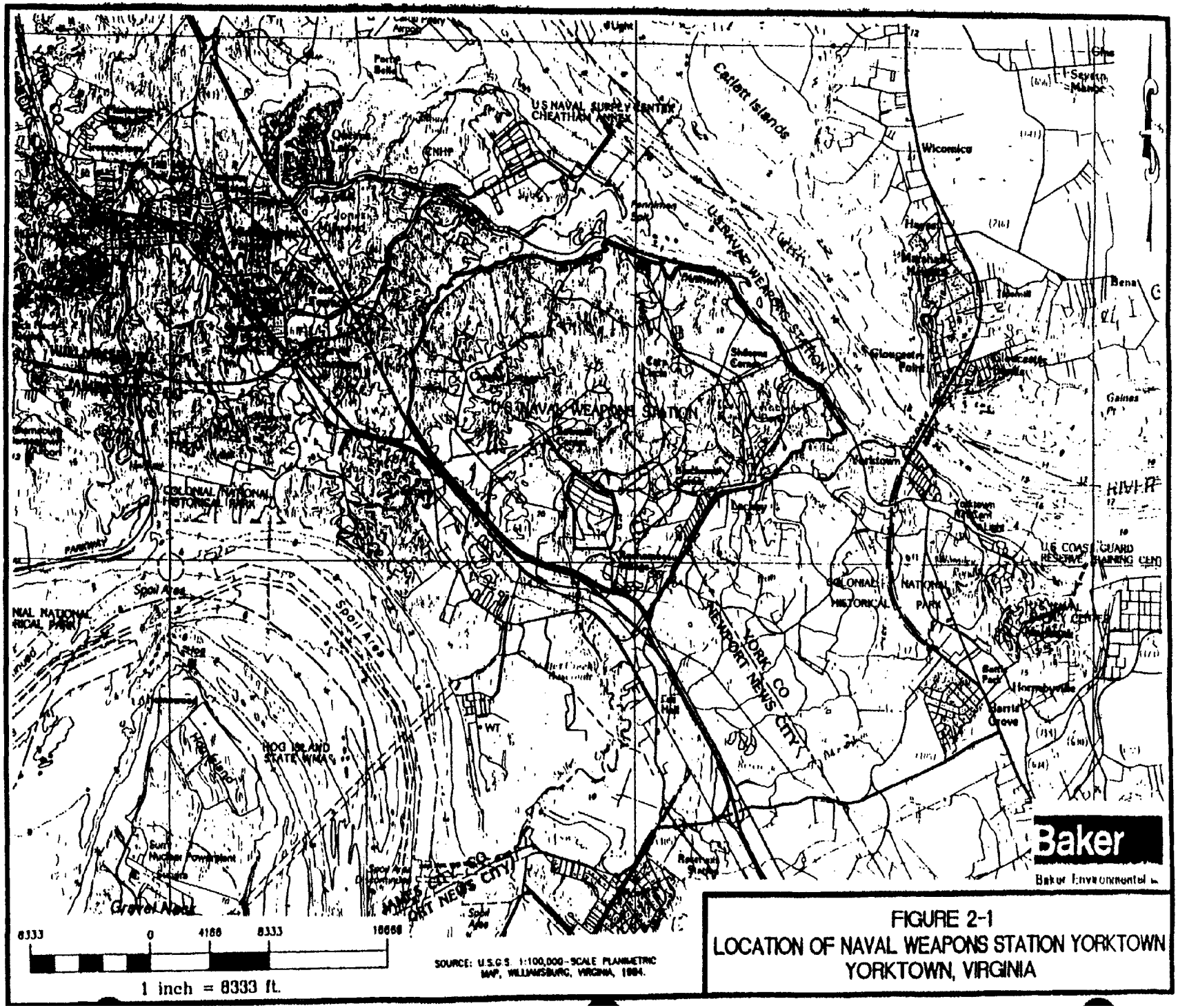
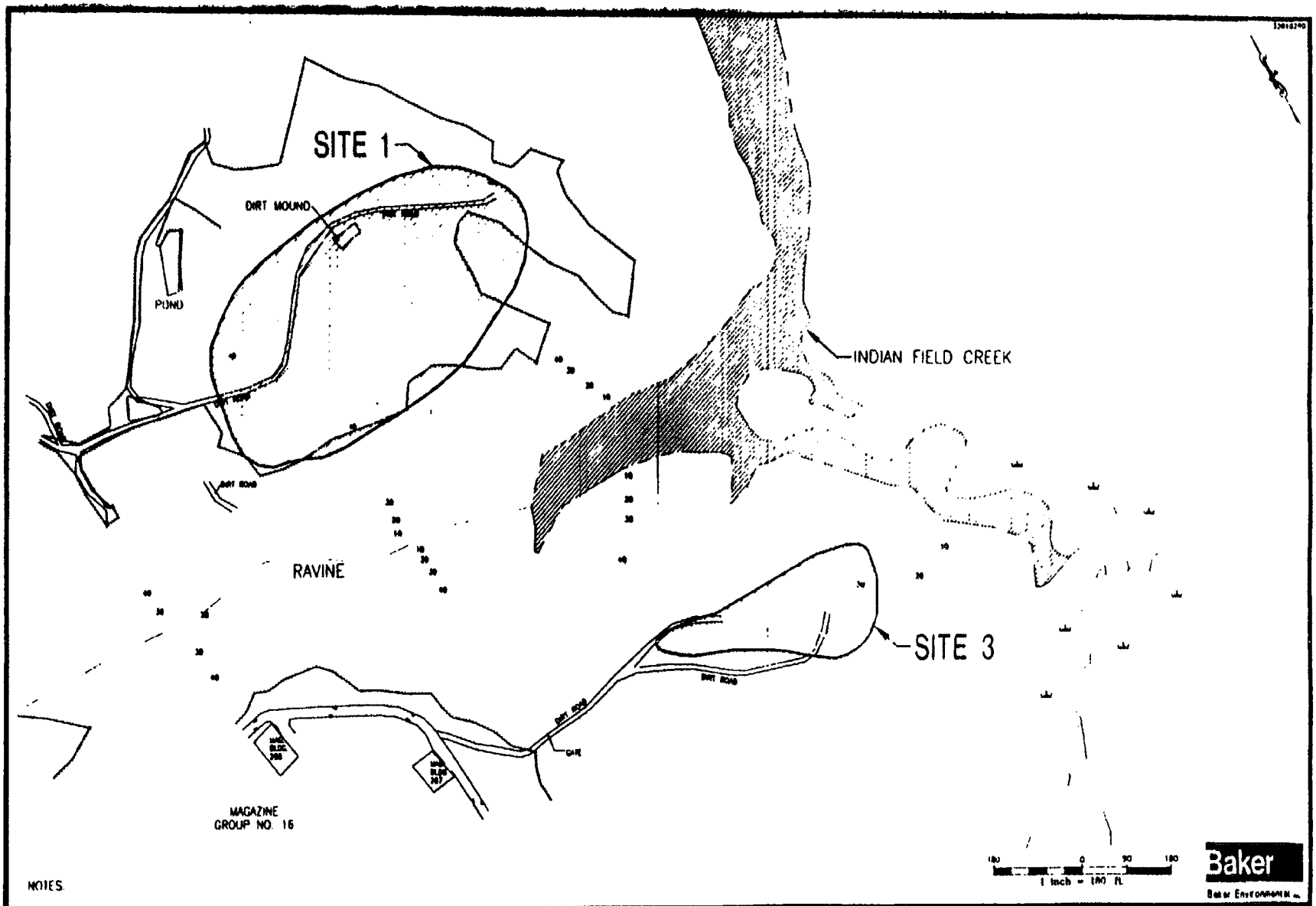


FIGURE 2-1
LOCATION OF NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA



NOTES:

1 ELEVATIONS SHOWN WERE TAKEN FROM AN ALUMINUM RIVET LOCATED IN CONCRETE HEADWALL N OF N RD TO AMMO OVERHAUL. BENCH MARK NUMBER MR-23 ELEVATION=44.11'

2 HORIZONTAL INFORMATION SHOWN WAS TAKEN FROM A DRAWING TITLED "HORIZONTAL SURVEYING CONTROL POINTS INDEX" BY TALBOT AND ASSOCIATES, LTD CODE IDENT. NO. 80091 SHEET NUMBER 1-7.

LEGEND

- EDGE OF WATER
- TREELINE
- EDGE OF PAVEMENT
- BUILDING
- WETLANDS
- DEBRIS AREA
- APPROXIMATE SITE BOUNDARY

SOURCE: PHR & A, AUGUST 1995

FIGURE 2-2
SITE PLAN OF SITES 1 AND 3

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

special tasks assigned to the facility, which included the design and development of depth charges and advanced underwater weapons. On August 7, 1959, the depot was redesignated the U.S. Naval Weapons Station. The primary mission of WPNSTA Yorktown is to provide ordnance, technical support, and related services to sustain the war-fighting capability of the armed forces in support of national military strategy.

Site 1 was originally used for sand mining, but became a landfill as depressional areas created by the mining activities were used for waste disposal. The landfill was operated under a Conditional Permit (No. 287) issued by the Commonwealth of Virginia. Disposed materials reportedly included asbestos insulation from steam piping; oil, grease, paint, and solvent containers; nitramine-contaminated carbon; household appliances; scrap metal banding; construction rubble; plastic lens grinding wastes; tree limbs; lumber, packaging wastes; electrical wires; and waste oil. General waste disposal activities occurred from approximately 1965 to 1979, but a portion of the site was reportedly used for plastic lens grinding waste disposal up until 1983. The landfill is covered by approximately two feet of soil.

The history of the Site 3 landfill is unrelated to operations at the Group 16 Magazines. The landfill area was reportedly in use from 1940 to 1970. Similar to Site 1, Site 3 was originally used for sand mining, but became a landfill as depressional areas created by mining activities were used for waste disposal. Wastes that were disposed at the site included solvents, sludge from boiler cleaning operations, grease trap wastes, settling tank s kimmings containing oil and grease, and animal carcasses. This landfill received an estimated 90 tons of waste. Currently, most of the site, which is overgrown with trees, is covered by approximately two feet of soil with some scattered surface debris.

2.2.2 Enforcement Activities

On October 15, 1992, WPNSTA Yorktown was included on the National Priorities List (NPL) because of the facility's proximity to wetlands and the potential impact on the surrounding environment. A Federal Facility Agreement (FFA) between the United States Environmmental Protection Agency (USEPA) Region III, the Commonwealth of Virginia, and the Department of the Navy (DoN) was finalized in August of 1994 for WPNSTA Yorktown. The FFA covers the investigation, development, selection, and implementation of response actions, satisfying WPNSTA Yorktown's Resource Conservation and Recovery Act (RCRA) corrective action obligations as well as appropriate provisions of CERCLA for all sites, RCRA Solid Waste Management Units (SWMUs), and RCRA Areas of Concern (AOCs).

No documented enforcement activities have been conducted to date at either Site or Site 3 under the FFA.

The following documents provide details of the site investigations and assessments of cleanup actions for OUs VIII and IX.

- C.C. Johnson & Associates, Inc. and CH2M Hill. Initial Assessment Study of Naval Weapons Station, Yorktown. July 1984.

- Dames & Moore. Confirmation Study Step 1A (Verification), Round One, Naval Weapons Station, Yorktown. Virginia. June 1986.

- Dames & Moore. Confirmation Study Step 1A (Verification), Round Two, Naval Weapons 5tation, Yorktown. Virginia. June 1988.

- Dames & Moore. Draft Remedial Investigation Interim Report, Naval Weapons Station, Yorktown, Virginia . February 1989.

- Baker Environmental, Inc. and Roy F. Weston, Inc. Final Round One Remedial Investigation Report for Sites 1-9, 11, 12, 16-19 and 21, Naval Weapons Station, Yorktown, Virginia. July 1993.

- Baker Environmental, Inc. Final Round Two Remedial Investigation Report, Sites 1 and 3, Naval Weapons Station Yorktown, Yorktown, Virginia . July 1997.

- Baker Environmental, Inc. Final Feasibility Study, Sites 1 and 3, Naval Weapons Station Yorktown, Yorktown, Virginia, October 1997.

2.2.3 History of Previous Investigations

The purpose of the Initial Assessment Study (IAS) (C.C. Johnson & Associates, Inc. and CH2M Hill, July 1984) was to identify and assess sites at WPNSTA Yorktown posing a potential threat to human health and/or the environment due to contamination from past operations. Nineteen potentially contaminated sites were identified based on information from historical records, aerial photographs, field inspections, and personnel interviews. Each site was evaluated for the type of contamination, migration pathways, and pollutant receptors. The IAS concluded that 15 of the 19 sites, including Sites 1 and 3, were of sufficient threat to human health and/or the environment to warrant Confirmation Studies.

A Confirmation Study was conducted for the 15 sites identified in the IAS. Two rounds of data were obtained during the Confirmation Study. The first round of data was collected in the winter of 1986. This effort was documented in the “Confirmation Study Step IA (Verification), Round One,” (Dames & Moore, 1986). The second round of sampling was conducted during November and December 1987. The results of the analyses and comparisons with appropriate regulatory standards were presented in the “Confirmation Study Step IA (Verification), Round Two,” (Dames & Moore, 1988).

The 15 sites, including Sites 1 and 3, were recommended in the Confirmation Study for further study and were evaluated as part of the Round One Remedial Investigation (RI), conducted in 1993. Soil, surface water, sediment and groundwater were collected and analyzed for Target Compound List (TCL) organic compounds, and Target Analyte List (TAL) inorganic compounds. Data generated during the Round One RI was compared with standards and/or available criteria and the sites were further recommended for additional investigation, if necessary. Sites 1 and 3 indicated the presence of contamination in soil and groundwater; therefore, these sites were targeted for a more comprehensive investigation and a baseline risk assessment to better evaluate the significance of site-related contamination.

To confirm the presence of the volatile organic compound (VOC), trichloroethene (TCE), in the groundwater at Site 1, an additional groundwater sample was collected from monitoring well 1 GW12 and analyzed for VOCs. This sample confirmed the presence of TCE in the groundwater.

The Round Two RI and report for Sites 1 and 3 were completed in July 1997 (Baker, 1997a). Additional soil data indicated that contamination was present at both sites. A potential hot spot of arsenic-contaminated soil (concentrations detected above screening levels and background) was identified at Site 1, and a potential hot spot of PAH- contaminated soil (concentrations detected above screening levels and background) was identified at Site 3. Subsequent hot spot delineation sampling was conducted at both sites. This additional sampling indicated that an arsenic hot spot was present at Site 1 in the surface soil near monitoring wells 1GW12A and 1GW12B. In addition, a PAH hot spot was identified and confirmed in the surface soil at Site 3 near surface soil sample location 3SS10. This additional sample data were used as part of the Feasibility Study (FS) Report (Baker, 1997b) to determine the extent of soil contamination.

2.3 Highlights of Community Participation

The Proposed Remedial Action Plan (PRAP) for Sites 1 and 3 (Baker, 1997c) was released to the public in May 1998 at the four information repositories listed below:

- York County Public Library
  8500 George Washington Highway
  Yorktown, VA 23692
  (757) 890-3377

- Newport News City Public Library
  366 Deshazor Drive
  Newport News, VA 23506
  (757) 247-8506

- Gloucester Public Library
  P.O. Box 367, Main Street
  Gloucester, VA 23601
  (804) 887-4720

- Naval Weapons Station Yorktown
  Environmental Directorate
  Building 31-B, P.O. Drawer 160
  Yorktown, VA 23691-0160
  (757) 887-4775 (ext. 29) (Contact: Mr. Jeff Harlow)

The notice of availability of this document was published on May 24, 1998, in the *Daily Press*. A public comment period was held from May 26, 1998 to July 11, 1998. A fact sheet that summarized the PRAP was distributed to attendees of the public meeting held at the York County Recreational Services Meeting Room, 301 Godwin Neck Road, Yorktown, Virginia, on May 26, 1998. This meeting was held to inform interested members of the community about the preferred remedial alternatives under consideration and to seek public comments. At the public meeting, representatives from the DoN, EPA, and VADEQ were available to answer questions about the sites and the remedial alternatives under consideration. A transcript of the public meeting is attached to this document as Appendix A. No comments were received during the public comment period.

2.4 Scope and Role of the Remedies

Sites 1 and 3 are part of comprehensive environmental investigations being conducted under the IR Program at WPNSTA Yorktown. OU VIII consists of arsenic-contaminated soil at Site 1. OU IX consists of PAH-contaminated soil at Site 3.

To protect human health and the environment, the arsenic- and PAH-contaminated soil hot spots at Site 1 and Site 3, respectively, will be excavated to a depth of approximately 2 feet. The soil will be transported off-site to an approved disposal facility. All excavated areas will be backfilled with clean soil and revegetated. Surficial debris will be removed from both sites and appropriately disposed or recycled. Land use controls will be implemented at the sites to prohibit residential development and activities that interfere with or compromise the integrity of the soil cover. In addition, at Site 1, portions of the existing soil cover will be restored by filling depressions and eroded areas with clean backfill, covering such areas with topsoil, and revegetating such areas.

2.5 Summary of Site Characteristics

2.5.1 Site 1 Site Characteristics

With respect to surface soil at Site 1, a potential hot spot of arsenic-contaminated soil near monitoring wells 1GW12A and 1GW12B was further delineated during the

additional sampling conducted after the Round Two R.I. Based on the surface soil sample, it was determined that the arsenic-contamination is a hot spot at Site 1. The Round Two Rl Report concluded that the subsurface soil at Site 1 has not been significantly impacted by the past disposal practices at the site. **Figure 2-3** identifies the arsenic hot spot and the analytical results.

With respect to shallow groundwater at Site 1, the VOC, TCE, appeared to have the most significant impact on the groundwater. During the Round One RI, TCE concentrations as high as 18,000 µgL were detected in monitoring well 1 GW12 in 1992. The sample collected from this same well during the confirmatory sampling conducted for the Round Two RI work plans in 1995 had a TCE concentration of 3,900 µg/L. During the Round Two RI (1996), the TCE concentrations detected at Site 1 were as high as 190 µg/L. Therefore, it appears that the TCE contaminant concentration in the shallow groundwater at the site decreased over time.

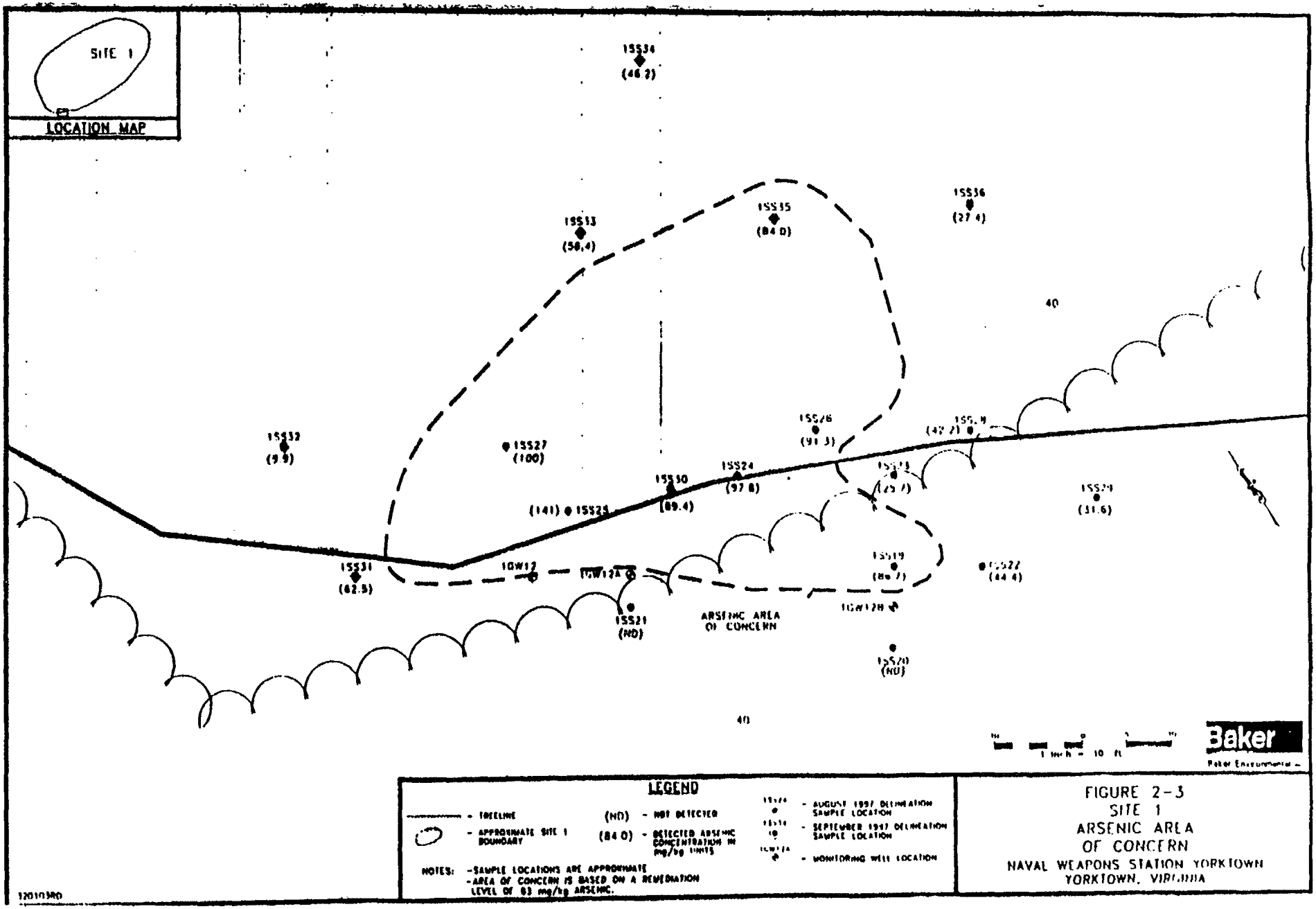
With respect to deep groundwater at Site 1, TCE was detected at a maximum concentration of 360 µg/L in monitoring well 1 GW I2B during the Round Two RI (1996). This well is located near the area where TCE was detected in the shallow groundwater. The TCE contamination appears to be limited to the upper portion of the deep aquifer. It is noted that deep groundwater at Site 1 was sampled only during the Round Two RI. The surface water and sediment associated with Site 1 were not impacted by past site operations.

2.5.2 Site 3 Site Characteristics

With respect to surface soil at Site 3, PAHs were detected at elevated concentrations in one of the surface soil samples (at the 3SS10 location) collected during the Round Two RI. Additional confirmatory soil samples were collected in 1996 around sample location 3SSI0 to confirm the presence of a PAH hot spot. The confirmatory sample results indicated that the elevated PAH concentrations were limited to the surface soil within a small area near sample location 3SSI0, which is in the eastern portion of the site. **Figure 2-4** identifies the PAH hot spot and sample results.

With respect to groundwater at Site 3, the Round Two RI results were consistent with the Round One RI results. VOC contamination appeared to be the highest near monitoring well 3GWI9 which is installed within the shallow portions of the Yorktown-Eastover aquifer (the shallow Columbia aquifer is not present at Site 3). Vinyl chloride (48 µg/L); 1,1-dichloroethene (48 µg/L)[1]; 1,2-dichloroethene (570 µg/L); and TCE (860 µg/L) were detected in the groundwater from this area. The groundwater samples collected at greater depths within this same aquifer showed a significant decrease of VOC concentrations.

[1] In 4J µg/L,the letter J represents a below detection limit qualifier



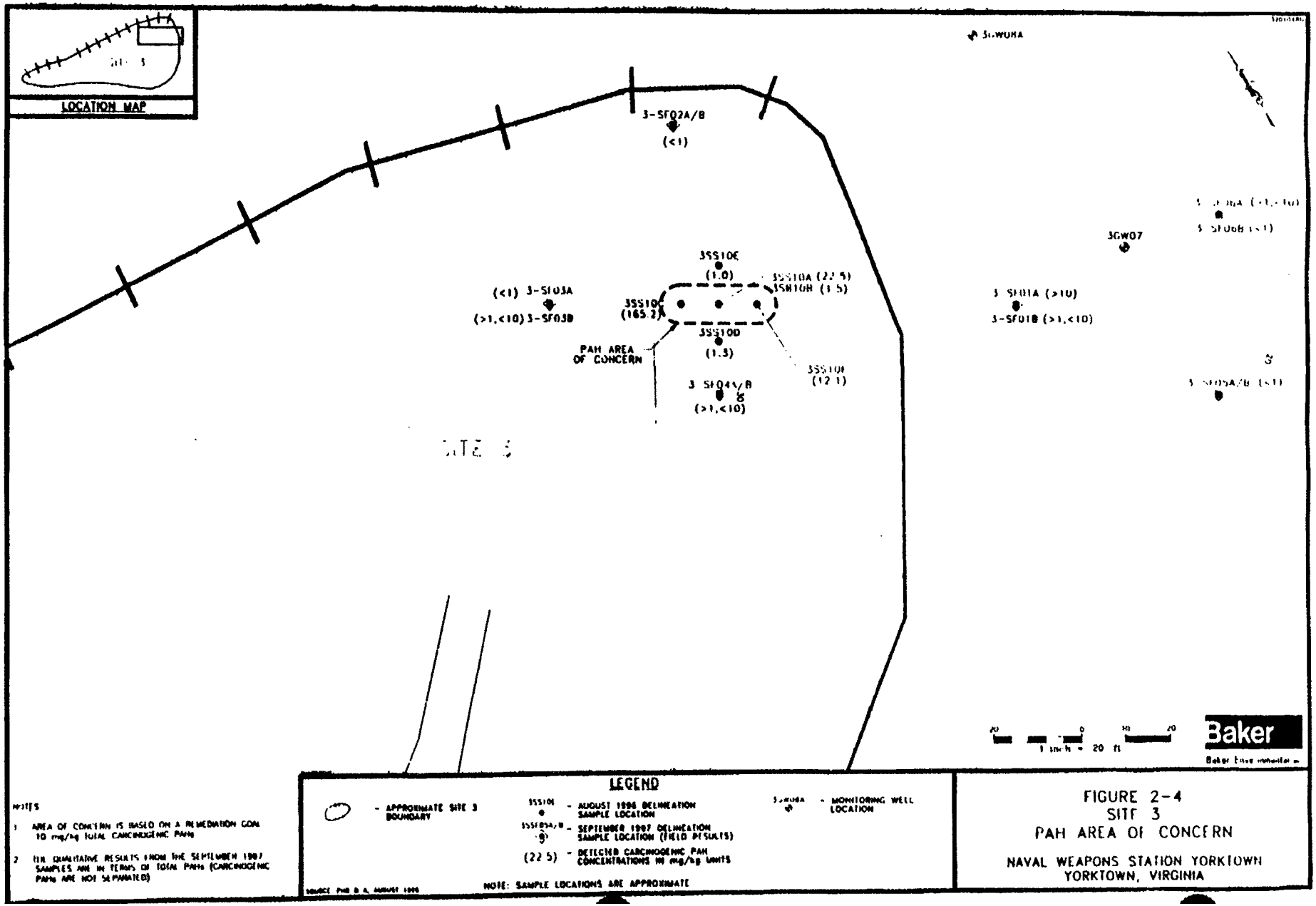
LEGEND

- FENCELINE
- APPROXIMATE SITE 1 BOUNDARY
- (ND) - NOT DETECTED
- (84.0) - DETECTED ARSENIC CONCENTRATION IN mg/kg UNITS
- SS24 - AUGUST 1997 DELINEATION SAMPLE LOCATION
- SS19 - SEPTEMBER 1997 DELINEATION SAMPLE LOCATION
- IGW12A - MONITORING WELL LOCATION

NOTES: -SAMPLE LOCATIONS ARE APPROXIMATE
-AREA OF CONCERN IS BASED ON A REMEDIATION LEVEL OF 83 mg/kg ARSENIC.

12010SRD

FIGURE 2-3
SITE 1
ARSENIC AREA
OF CONCERN
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA


LOCATION MAP
3-SF02A/B
(<1)
3SS10E
(1.0)
3SS10A (22.5)
3SS10B (1.5)
(<1) 3-SF03A
3SS10C
(165.2)
(>1,<10) 3-SF03B
3SS10D
(1.3)
PAH AREA
OF CONCERN
3SS10F
(12.1)
3 SF04A/B
(>1,<10)
3GW07
3 SF01A (>10)
3-SF01B (>1,<10)
20 0 20
1 inch = 20 ft
Baker
NOTES
1 AREA OF CONCERN IS BASED ON A REMEDIATION GOAL OF 10 mg/kg TOTAL CARCINOGENIC PAHs
2 EIR QUALITATIVE RESULTS FROM THE SEPTEMBER 1997 SAMPLES ARE IN TERMS OF TOTAL PAHs (CARCINOGENIC PAHs ARE NOT SEPARATED)
LEGEND
- APPROXIMATE SITE 3 BOUNDARY
3SS10E - AUGUST 1996 DELINEATION SAMPLE LOCATION
3SS10A/B - SEPTEMBER 1997 DELINEATION SAMPLE LOCATION (FIELD RESULTS)
(22.5) - DETECTED CARCINOGENIC PAH CONCENTRATIONS IN mg/kg UNITS
- MONITORING WELL LOCATION
NOTE: SAMPLE LOCATIONS ARE APPROXIMATE
FIGURE 2-4
SITE 3
PAH AREA OF CONCERN
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

2.6 Summary of Site Risks

A baseline risk assessment (RA) was conducted as part of the Sites 1 and 3 Round Two Remedial Investigation Report (Baker, 1997a). Both human health and ecological RAs were conducted. This section summarizes the results of the baseline RA and those contaminants associated with unacceptable human health risks and potential adverse ecological effects.

Human health risks are described by evaluating noncarcinogenic (systemic) and carcinogenic health effects. Reference dose (RfDs) values have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of potential concern (COPCs) exhibiting noncarcinogenic effects, RfDs, which are expressed in units of mg/Kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. RfDs are derived from human epidemiological data or animal studies to which uncertainty factors have been applied to account for the use of animal data to predict effects on humans. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur. The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g, lifetime) with a reference dose for a similar exposure period. The ratio of exposure to the reference dose is called a hazard quotient (HQ). HQ values are then summed to produce hazard indices (HIs) for each potential receptor and means of exposure (dermal, ingestion, inhalation). If a hazard index is greater than or equal to 1.0, the contaminants included in the hazard index are re-examined to see whether they affect the same target organ (e.g., liver). If they do not, new hazard indices are computed, summing HQ values only for contaminants that affect a single target organ. Contaminants that affect a single target organ and produce a hazard index greater than or equal to 1.0 are considered to be chemicals of concern (COCs) and remedial action is considered to reduce the risk of adverse, noncarcinogenic health effects in the exposed population.

Carcinogenic human health risks are expressed as a probability known as an incremental lifetime cancer risk (ICR). This risk is the incremental probability that an individual will develop cancer in his or her lifetime following exposure to a contaminant. These risks are usually expressed in scientific notation (e.g., 1×10^{-6}). An incremental lifetime cancer risk of 1×10^{-6}, for example, indicates that an individual who receives an estimated reasonable maximum exposure to contaminants at a site has a 1 in 1,000,000 chance of developing cancer as a result. This is referred to as an "incremental lifetime cancer risk" because it would be in addition to the risks of cancer that individuals face from other causes (for example, smoking). The ICR values for all potentially carcinogenic COPCs to which a person may be exposed are added together. The total ICR value is compared to EPA's generally acceptable risk range of 1×10^{-4} to 1×10^{-6}. The generally acceptable risk range is the range of cancer risks considered to be acceptable at most sites under most circumstances. For example, the upper end of USEPA's acceptable risk range, $1 \text{ X } 10^{-4}$, means that one additional cancer case is estimated to occur in an exposed population of 10,000 as a result of exposure to the site. It can also mean that an individual with an ICR

value of 1 x 10^{-4} has an estimated increased probability of 0.01% of contracting cancer following exposure over the course of a lifetime.

ICR values of 10^{-4} or greater are evaluated to identify those contaminants in environmental media responsible for 95% of the unacceptable risk. These chemicals are considered to be COCs and remedial action is considered to reduce the cancer risk.

Because WPNSTA Yorktown was placed on the National Priority List (NPL) as a result of ecological concerns (proximity to wetlands, etc.), potential ecological receptors are also evaluated at each site. Terrestrial and aquatic receptors are evaluated by: (1) a general comparison to existing toxicity criteria; and (2) conservative contaminant uptake modeling to establish a site specific body burden in an animal or organism and a comparison to published toxicity data for a similar animal or organism. Both phases of the ecological risk assessment culminate with the calculation of ecological HQs. Ecological HQ values greater than or equal to 1.0 indicate the potential for adverse effects on the environment, and chemicals producing these values are considered ecological contaminants of concern. Remediation of these contaminants must be considered carefully, so that the selected remedy does not create more short-term harm to the ecological receptors than is produced by leaving contaminants in place. For example, scientists must decide if more damage will be done by removing sediments and destroying a wetland or by having contaminants remain in the sediment.

2.6.1 Human Health Risk Assessment Summary

For both Sites 1 and 3, the human health RA was conducted for surface soil, shallow subsurface soil, groundwater, surface water, and sediment. Surface soil and shallow subsurface soil were evaluated for Sites 1 and 3 separately. Shallow groundwater (i.e., the Columbia aquifer) was only evaluated for Site 1 because this aquifer does not exist at Site 3. Deep groundwater (i.e., the Yorktown-Eastover aquifer), surface water, and sediment were evaluated for Sites 1 and 3 combined. Because groundwater at sites 1 and 3 and Indian Field Creek surface water and sediment will be sampled in the future, they will be addressed as a separate OU when data become available. As such, they will not be addressed in this section.

Current and future potential human exposure scenarios were evaluated. The current exposure scenarios included: on-Station adult trespasser and on-Station adolescent trespasser. The future potential exposure scenarios included: future adult and child on-site residents and future adult construction workers. Because of the nature of activities conducted at and around Sites 1 and 3, potential current human exposure is limited. Both sites lie within the Explosive Safety Quantity Distance (ESQD) arc (associated with the storage of munitions) and inside the restricted area of the Station. Residential development is not permitted in these areas. Current and future potential human receptors evaluated in the baseline human health RA for Sites 1 and 3 include:

- Adult On-Station Trespassers

- Adolescent On-Station Trespassers (7 to 15 years old)
- Future On Site Resident Adults
- Future On-Site Resident Children (1 to 6 years old)
- Future On -Site Adult Construction Workers

The adult and adolescent trespasser scenario is unlikely, but assumes that Station personnel and adolescent family members would trespass onto the site for recreational purposes. The exposure potential was assumed to occur up to 143 days per year for 4 years. This estimate is conservative because current property use restrictions prohibit this type of exposure at Sites 1 and 3.

Future residential development is unlikely at Sites 1 and 3 because they fall within the restricted area of the Station. However, the future on-site adult and young child resident scenario was evaluated to address all types of potential exposure and provide a conservative estimate of future human risk. Future adult and young child residents were evaluated for potential exposure to groundwater, surface soil, surface water, and sediment. An exposure frequency for surface soil of 350 days per year with durations of 24 years for adults and 6 years for child residents was used. For groundwater, surface water, and sediment, an exposure frequency of 40 days per year for the same durations as for surface soil was assumed. These potential receptors were selected based on information available regarding the physical features, site setting, site historical activities, and current and anticipated land uses. Potential on-Station trespassers include WPNSTA personnel and younger family members that may access the sites for recreational purposes. Potential exposure to the contaminants of potential concern (COPCs) for these potential current receptors includes accidental ingestion of and dermal contact with surface soil, surface water, and sediment. Total risks were estimated by site for the current potential trespassers using both the reasonable maximum exposure (RME) and the central tendency (CT). The RME is the highest exposure that is reasonably expected to occur at a site and in practice is estimated by combining upper bound (90th and 95th percentile) values (USEPA, 1989). CT describes the arithmetic mean risk or median risk (USEPA, 1992).

Despite the unlikely possibility of residential development by the military or the general public, future residential exposure by children and adults was evaluated in the RA to provide a conservative evaluation of potential risks associated with these sites. Potential exposure to the COPCs for these potential future receptors includes ingestion of and dermal contact with surface soil, groundwater, surface water, and sediment. In addition, there is potential exposure to adults with respect to inhalation of VOCs present in shower water (groundwater). However, groundwater quality in the shallow aquifers (Cornwallis Cave and Upper Yorktown-Eastover) precludes potable use. Although pump tests were not performed for the Cornwallis Cave or Upper Yorktown-Eastover aquifers in the vicinity of Sites 1 and 3, these aquifers produce low yields (0 to 10 gallons per minute throughout WPNSTA Yorktown) and contain naturally-occurring concentrations of inorganics including iron and manganese in excess of Secondary Maximum Contaminant Levels (SMCLs). Measurements of pH during groundwater sampling and calculated hardness exceeded the SMCLs and the Virginia groundwater quality standards,

respectively. Based on field observations obtained during well purging and development, neither the Cornwallis Cave nor the Yorktown-Eastover aquifer would sustain a residential household requiring 150 gallons of water per day in the vicinity of Sites 1 and 3. As such, potable aquifer use is not possible in the vicinity of Sites 1 and 3. Groundwater will not be addressed in this ROD; instead, groundwater will be investigated under a separate investigation. Total risks were estimated by site for the future potential residents using both the RME and the CT.

Future construction workers were evaluated for subsurface soil exposures for each site.

For each exposure route and potentially exposed population, ICR values and HI values were calculated to quantify potential risks. The following subsections present a summary of unacceptable risks (i.e., ICR values > $1.0x10^{-4}$ and HI values $ 1.0) for potential human receptors.

2.6. 1.1 Site 1 Human Health Risks

Tables 2-1 through **2-5** present the COPCs evaluated in the human health RA for Site 1. As presented on **Table 2-6**, total ICR values for the current adult and adolescent on-Station trespassers at Site 1 fell within the USEPA's generally acceptable target risk range of 1.0×10^{-6} to 1.0×10^{-4}. HI values presented for current potential human receptors at Site I fell below 1.0, indicating that noncarcinogenic adverse human health risks will probably not occur subsequent to exposure.

Table 2-7 presents total residential lifetime risks resulting from summing overall potential adult and child risks for Site 1. Risks calculated for the future construction worker were within acceptable levels. As can be seen from **Table 2-7**, total RME noncarcinogenic risks to the future child resident exceeded acceptable criteria (1.0) for the surface soil pathway (HI= 1.5). ICR values for the future adult resident and child resident fell within the acceptable target risk range for all evaluated media at Site 1.

Risk from the surface soils were evaluated further to determine those contaminants responsible for the elevated HI value for the future child receptor. **Table 2-8** presents the individual contaminant risk values (ICRs and HIs) for the surface soil medium pathway for future residential receptors. It should be noted that the individual contaminant HIs did not exceed unity; however, cumulatively, the HI value exceeds unity for the child resident. Summing the ingestion and dermal effects of the contaminants, the primary contributor to the HI value is arsenic [hazard quotient (HQ)=0.95] followed by iron (HQ=0.42), aluminum (HQ= 0.11), and beryllium (HQ=0.001). These contaminants have separate target organs from which reference doses were derived. The target organ for arsenic is the skin (keratosis/hyperpigmentation), aluminum and beryllium do not have known target organs, and the target organs for iron include the hepatic parenchyma (fibrosis), the heart (cardiac dysfunction and failure), and the endocrine glands (hypogonadism). As such, the HQ values cannot be summed and noncarcinogenic adverse health effects will not occur subsequent to exposure.

Arsenic concentrations exceeding Station-wide background concentrations were identified in the surface soil and additional samples were collected, for purposes of the FS, to define the extent of contamination. These data were not evaluated in the Round Two RI baseline RA because the Round Two RI had already been completed. Arsenic concentrations exceeding background concentrations would cause unacceptable human health risks if exposure were to occur in the area. As such, arsenic at Site 1 was retained as a COPC for further evaluation in the FS in order to define the extent of contamination for remediation.

TABLE 2-1

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
SEMIVOLATILE (ug/kg)					
BENZO(A)PRYENE	6/21	69J - 380J	350 - 480	170.48	140J - 180J
INORGANICS (mg/kg)					
ALUMINUM	21/21	1,930 - 11,200	NA -NA	4,811.90	1,960 - 24,100
ARSENIC (2)	20/20	0.64L - 43.5	NA - NA	4.39	0.466 - 63.9
BERYLLIUM	15/21	0.21 - 0.55	0.14 - 0.15	0.25	0.23J - 0.93J
IRON	21/21	2,510 - 11,700	NA - NA	5,545.71	1,440 - 19,900

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
(2) Only 20 samples within sample set because sample 1SBRA-00 initiated an Area of Concern
NA - Not Applicable
J - estimated value

TABLE 2-2

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 1 - AREA OF CONCERN
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	RANGE OF STATION BACKGROUND (1)
INORGANICS (mg/kg)				
ARSENIC	17/19	92.5-141	0.10-0.10	0.466-63.9

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable

TABLE 2-3

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - PROPER
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	RANGE OF STATION BACKGROUND
SEMIVOLATILES (UG/KG)				
BENZO(A) PRYENE	1/15	160J	350 - 480	140J - 180J
INORGANICS (MG/KG)				
ALUMINUM	15/15	1,930 - 11,200	NA - NA	1,960 - 24,100
ANTIMONY	2/15	4.6L - 16.8L	3.1UL - 5.2UL	9.2L - 11L
ARSENIC	15/15	1.2 - 6.9	NA - NA	0.466 - 63.9
BERYLLIUM	14/15	0.20 - 1.5	0.18 - 0.18	0.23J - 0.93J
IRON	15/15	2,460 - 23,800	NA - NA	1,440 - 46,400
MANGANESE	15/15	6.7 - 667	NA - NA	7.6L - 491

Notes:

(1) Data considers both Station-wide and Anthropogenic Background Samples

NA - Not Applicable

J - estimated value

L - estimated biased low

TABLE 2-4

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - AOC
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	RANGE OF STATION BACKGROUND
SEMIVOLATILES (ug/kg)				
BENZO(A)ANTHRACENE	6/6	160J - 92,000	NA - NA	120J - 240J
BENZO(B)FLOURANTHENE	6/6	120J - 98,000	NA - NA	140J - 180J
BENZO(A) PRYENE	6/6	170J - 77,000	NA -NA	230J - 500
CARBAZOLE	6/6	43J - 37,000	NA -NA	ND
DIBENZO(a,h)ANTHRACENE	5/6	41J - 12,000	410 - 410	ND
INDENO(1,2,3-cd)PYRENE	6/6	120J - 147,000	NA - NA	160J - 160J
INORGANICS (mg/kg)				
ALUMINUM	1/1	10,000	NA - NA	19,600 - 24,100
ARSENIC	1/1	9.5	NA -NA	0.466 - 63.9
BERYLLIUM	1/1	0.98	NA -NA	0.23J - 0.93J
IRON	1/1	8,040	NA - NA	1,440 - 46,400
LEAD	1/1	59.4	NA - NA	6.4 - 43.1
MANGANESE	1/1	1,580	NA - NA	7.6L - 491
VANADIUM	1/1	142	NA - NA	61J - 34.7J

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable
ND - Nondetect
J - estimated value
L - estimated biased low

TABLE 2-5

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SHALLOW SUBSURFACE SOIL SAMPLE ANALYSIS
SITE 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	RANGE OF STATION BACKGROUND (1)
SEMIVOLATILES (ug/kg)				
BENZO(A) PRYENE	3/13	59J - 130J	350 - 590	140J - 180
INDENO (1, 2,3-CD) PYRENE	3/13	66J - 140J	350 - 590	160J
INORGANICS (mg/kg)				
ARSENIC	13/13	0.32L - 126L	NA - NA	0.23L - 42.7L
BERYLLIUM	11/13	0.12 - 0.38	0.14 - 0.15	0.3J - 9.8
IRON	13/13	1,660 - 9,450	NA - NA	3,810J - 51,100J

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable
J - estimated value
K - estimated biased high
L - estimated biased low

TABLE 2-6

INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES FOR CURRENT POTENTIAL HUMAN RECEPTORS - PER MEDIA AT SITE I NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

	Current Potential Receptors			
	Adult Trespassers		Adolescent Trespassers	
Pathway	ICR	HI	ICR	HI
Surface Soil				
Ingestion	4.4×10^{-07}	0.02	8.4×10^{-07}	0.04
Dermal Contact	2.0×10^{-06}	0.01	2.5×10^{-06}	0.1
Subtotal	2.5 x 10-^{07}	0.1	3.3×10^{-06}	0.1
Surface Water (1)				
Ingestion	NA	0.2	NA	0.04
Dermal Contact	NA	0.4	NA	0.04
Subtotal	NA	0.06	NA	0.08
Sediment				
Ingestion	2.5×10^{-07}	0.01	4.7×10^{-07}	0.02
Dermal Contact	8.8×10^{-07}	0.05	1.1×10^{-06}	0.06
Subtotal	1.1×10^{-06}	0.06	1.6×10^{-06}	0.08
TOTAL	3.6×10^{-06}	0.2	4.9×10^{-06}	0.3

Notes:

(1) Risk value derived using organic and total inorganic concentrations.
NA - Not applicable. No carcinogens were retained as COPCs in Sites 1 and 3 surface water.
ICR - Incremental Cancer Risk
HI - Hazard Index

TABLE 2-7

INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES
FOR FUTURE POTENTIAL HUMAN RECEPTORS
RME AND CENTRAL TENDENCY VALUES
SITE I
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

	Future Potential Receptors[1]					
	Residential Adults		Residential Children (1-6 yrs.)		Construction Worker	
Pathway	ICR	HI	ICR	HI	ICR	HI
Surface soil						
Ingestion	1.3×10^{-05} (9.0×10^{-07})	0.1 (0.02)	3.0×10^{-05} (5.6×10^{-06})	1.1 (0.2)	NA NA	NA NA
Dermal Contact	2.8×10^{-05} (8.7×10^{-07})	0.2 (0.02)	1.3×10^{-05} (9.4×10^{-07})	0.4 (0.03)	NA NA	NA NA
Subtotal	4.1×10^{-05} (1.8×10^{-06})	0.3 (0.04)	4.3×10^{-05} (6.5×10^{-06})	1.5 (0.2)	NA NA	NA NA
Subsurface Soil						
Ingestion	NA	NA	NA	NA	3.4×10^{-06}	0.51
Dermal Contact	NA	NA	NA	NA	1.1×10^{-06}	0.15
Subtotal	NA	NA	NA	NA	4.5×10^{-6}	0.66
Surface Water						
Ingestion	NA (NA)	0.01 (0.01)	NA (NA)	0.03 (0.02)	NA NA	NA NA
Dermal Contact	NA (NA)	0.01 (0.01)	NA (NA)	0.02 (0.01)	NA NA	NA NA
Subtotal	NA (NA)	0.02 (0.02)	NA (NA)	0.05 (0.03)	NA NA	NA NA

TABLE 2-7 (Continued)

INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES FOR FUTURE POTENTIAL HUMAN RECEPTORS RME AND CENTRAL TENDENCY VALUES SITE 1 NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

	Future Potential Receptors[1]					
	Residential Adults		Residential Children (1-6 yrs.)		Construction Worker	
Pathway	ICR	HI	ICR	HI	ICR	HI
Sediment						
Ingestion	8.3×10^{-07} (1.0×10^{-7})	0.01 (<0.01)	1.9×10^{-06} (6.5×10^{-07})	0.1 (0.02)	NA NA	NA NA
Dermal Contact	1.5×10^{-06} (7.0×10^{-08})	0.01 (<0.01	6.5×10^{-07} (7.6×10^{-08})	0.02 (<0.01)	NA NA	NA NA
Subtotal	2.3×10^{-06} (1.7×10^{-07})	0.02 (<0.01)	2.6×10^{-06} (7.3×10^{-07})	0.12 (0.02)	NA NA	NA NA

Note:

(1) Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{06} to 1.0×10^{-04} and target HI value of 1.0). Values not in parentheses represent RME values. Values in parentheses represent central tendency risks.

RME - Reasonable Maximum Exposure
NA - Not Applicable
ICR - Incremental Cancer Risk
HI - Hazard Index

TABLE 2-8

INDIVIDUAL CONTAMINANT RISK VALUES FOR SURFACE SOIL - FUTURE POTENTIAL HUMAN RECEPTORS SITE 1 NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

		Future Potential Receptors[1]			
		Future Residential Adult		Future Residential Children (1-6 yrs.)	
Medium/Pathway	Chemical	ICR	HI	ICR	HI
Surface Soil					
Ingestion	Benzo(a)pyrene	6.75×10^{-07}	--	1.57×10^{-06}	--
	Aluminum	--	0.0078	--	0.073
	Arsenic	1.17×10^{-05}	0.076	2.73×10^{-05}	0.71
	Beryllium	6.06×10^{-07}	0.00008	1.41×10^{-06}	0.00077
	Iron	–	0.03		0.28
Surface Soil					
Dermal Contact	Benzo(a)pyrene	7.15×10^{-06}	--	$3.16x 10^{-06}$	--
	Aluminum	--	0.021	--	0.036
	Arsenic	2.09×10^{-05}	0.14	9.22×10^{-06}	0.24
	Beryllium	1.61×10^{-06}	0.00022	$7.09- \times 10^{-07}$	0.00038
	Iron	–	0.079	–	0.14
Surface Soil Total		4.1×10^{-05}	0.3	4.3×10^{-05}	1.5

Notes:

(1) Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{06} to 1.0×10^{-04} and target HI value of 1.0).

ICR - Incremental Cancer Risk
HI - Hazard Index
RME - Reasonal Maximum Exposure

2.6.1.2 Site 3 Human Health Risks

Tables 2-9 through **2-11** present the COPCs evaluated in the human health RA for Site 3. As presented on **Table 2-12,** there are no unacceptable carcinogenic or noncarcinogenic risks to potential current receptors calculated for the surface soil evaluated in Site 3 Proper. As shown on **Table 2-12,** the ICR values estimated for RME current trespasser receptors (ICR=1.70 x 10^{-4} for adults and ICR=2.20 x 10^{-4} for adololescents) exposed to the PAH hot spot surface soil exceeded the USPEA's target risk range of 1 x 10^{6} to 1 x 10^{-4}. The noncarcinogenic risks were below unity for the potential current receptors. The elevated ICR is due primarily to the presence of benzo(a)pyrene (**Table 2-13**). If the PAH hot spot is removed form the risk calculations, the surface soil ICR values fall within acceptable levels.

In the future scenario, the surface soil pathway for Site 3 Proper presents noncarcinogenic risks above accepted criteria (HI=1.6) for the child resident receptor (**Table 2-14**). The RME ICR values for the surface soil pathway in the future scenario were calculated within USEPA's target range of 1.0 x 10^{-6} to 1.0 x 10^{-4}.

Risks to future receptors from surface soil exposure at Site 3 Proper were evaluated further to determine those contaminants responsible for the elevated HI value. **Table 2-15** presents the individual contaminant risk values (ICR and HIs) for the surface soil medium pathway for future residential receptors. It should be noted that the individual contaminant HQ values did not exceed 1.0; however, cumulatively the HI value exceeds unity for the residential child. The primary contributor to the HI at Site 3 Proper (including both ingestion and dermal effects) is iron (HQ=0.75), followed by manganese (HQ=0.31), antimony (HQ=0.24), arsenic (HQ=0.20), aluminum (HQ=0.11), and beryllium (HQ=0.0024). The target organs for risk driving chemicals include the hepatic parenchyma (fibrosis), the heart (cardiac dysfunction and failure), and the endocrine glands (hypogonadism) for iron; the skin (keratosis/hyperpigmentation) for arsenic; and the central nervous system and lungs for manganese. Aluminum and beryllium do not have known target organs and the target organ for antimony is not clearly defined, but may include whole body effects and the blood. Since the effects of the contaminants on the target organs are unknown, the HQ values cannot be summed and noncarcinogenic adverse health effects will not occur subsequent to exposure at Site 3 Proper.

With Respect to the future scenario, the surface soil from the PAH hot spot presented both unacceptable carcinogenic risks (ICR=2.6 x 10^{-3} for adults and ICR=1.50 x 10^{-3} for children) and unacceptable noncarcinogenic risks (HI=1.4 for adults and HI=4.2 for children). **Table 2-15** presents the individual contaminant risk values (ICRs and HIs) for the PAH hot spot surface soil medium pathway for future residential receptors. As shown on this table, the primary contributors to the ICR are benzo(a)pyrene (ICR=1.61 x 10^{3} for adults and ICR=7.12 x10^{-4} for children) and other carcinogenic PAHs listed in **Table 2-15** which exceeded EPA's acceptable risk criteria. Carcinogenic PAHs were retained as COPCs for the surface soil PAH hot spot.

As shown on **Table 2-15**, the noncarcinogenic risks for the PAH hot spot surface soil pathway in the future scenario (HI=1.4 for adult and HI=4.2 for children) are primarily a result of dermal and ingestion exposure to concentrations of manganese (HQ=1.05 for adult and HQ=2.54 for children) and also from concentrations of aluminum (HQ=0.05 for adult and HQ=0.2 for children), arsenic (HQ=0.12 for adult and HQ=0.54 for children), beryllium (HQ=0.001 for adult and HQ=0.004 for children), iron (HQ=0.13 for adult and HQ=0.51 for children), and vanadium (HQ=0.10 for adult and HQ=0.39 for children). The target organs for risk driving chemicals include the central nervous system and lungs for manganese; the skin (keratosis/hyperpigmentation) for arsenic, and the hepatic parenchyma (fibrosis), the heart (cardiac dysfunction and failure), and the endocrine glands (hypogonadism) for iron. Aluminum, beryllium, and vanadium do not have known target organs and the target organ for antimony is not clearly defined, but may include whole body effects and the blood. As such, the HQ values cannot be summed. However, manganese HQs are greater than unity for the adult and child future residents. The manganese concentration detected in the PAH hot spot at Site 3 exceeded the HQ value of 1 and the range of background soil concentrations. It is noted that the risks to humans from aluminum, beryllium, and vanadium in the PAH hot spot were based on one soil sample. Aluminum, beryllium, and vanadium were not retained as COPCs in the PAH hot spot at Site 3 because only the manganese concentration exhibited an HQ value above 1. The carcinogenic PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno (1,2,3-cd) pyrene, and dibenzo(ah) anthracene) were determined to be the primary COPCs in this area.

TABLE 2-9

**SUMMARY OF HUMAN HEALTH CHEMICALS Of POTENTIAL CONCERN
FROM SURFACE WATER SAMPLE ANALYSIS
SITES 1 AND 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA**

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
INORGANICS (mg/kg)					
CADMIUM	4/4	7.8L - 9.1L	NA - NA		5.1K - 6.7K
IRON	4/4	1,220J - 3,250J	NA - NA		289J - 6,650

Notes:
(1) From Background Report (Baker, 1995)
NA - Not applicable
J - estimated value
K - estimated biased high
L - estimated biased low

TABLE 2-10

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - AOC
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
SEMIVOLATILES (ug/kg)					
CARBAZOLE	6/6	43J - 37,000	NA - NA	8,087.67	NA
BENZO(A)ANTHRACENE	6/6	160J - 92,000	NA - NA	21,008.33	NA
BENZO(B)FLOURANTHENE	6/6	120J - 98,000	NA - NA	24,015.00	NA
BENZO(K)FLOURANTHENE	6/6	0.13J - 32J	NA - NA	6,755.00	NA
BENZO(A)PRYENE	6/6	170J - 77,000	NA - NA	19,050.00	NA
INDENO(1,2,3-cd)PYRENE	6/6	120j - 147,000	NA - NA	11,413.33	NA
DIBENZO(a,h)ANTHRACENE	5/6	41J - 12,000	410 -410	2,516.00	NA
INORGANICS (mg/kg)					
ALUMINUM	1/1	10,000	NA - NA	NA	19,600 - 24,100
ARSENIC	1/1	9.5	NA - NA	NA	0.466 - 63.9
BERYLLIUM	1/1	0.98	NA - NA	NA	0.23J - 0.93J
IRON	1/1	8,040	NA - NA	NA	1,440 - 46,400
MANGANESE	1/1	1,580	NA - NA	NA	7.6L -491
VANADIUM	1/1	142	NA - NA	NA	6.1J - 34.7J

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable
J - estimated value
L - estimated biased low

TABLE 2-11

SUMMARY OF HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN
FROM SHALLOW SUBSURFACE SOIL SAMPLE ANALYSIS
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
INORGANICS (mg/kg)					
ALUMINUM	7/7	2,680 - 15,100	NA - NA	10,747.14	2,710 - 28,200
ARSENIC	7/7	0.67L - 13.2L	NA - NA	5.94	0.23J - 42.7
BERYLLIUM	7/7	0.17 - 3.9	NA - NA	1.54	0.3J - 9.8
CHROMIUM	7/7	3.5K - 65	NA - NA	35.63	5.2L - 33.5
IRON	7/7	3,330 - 72,700	NA - NA	32,475.71	3.91J - 51,100J
IMANGANESE	7/7	17.8 - 269	NA - NA	99.91	3.5J - 2,940
VANADIUM	7/7	4.8 - 84	NA - NA	34.53	7.8J - 70.3L

Notes:
(1) Inorganic data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable
J - estimated value
K - estimated biased high
L - estimated biased low

TABLE 2-12
INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES
FOR CURRENT POTENTIAL HUMAN RECEPTORS
RME AND CENTRAL TENDENCY VALUES
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Medium/Pathway	Current Potential Receptors [1]					
	Adult Trespasser		Adolescent Trespasser (7-15 yrs.)		Construction Worker	
	ICR	HI	ICR	HI	ICR	HI
Subsurface Soil						
Ingestion	1.5×10^{-07} (6.1×10^{-08})	0.02 (0.01)	2.8×10^{-07} (1.2×10^{-07})	0.04 (0.02)	NA NA	NA NA
Dermal Contact	9.3×10^{-07} (1.7×10^{-07})	0.2 (0.02)	1.2×10^{-06} (1.9×10^{-07})	0.2 (0.02)	NA NA	NA NA
Subtotal	1.1×10^{-06} (2.3×10^{-07})	0.2 (0.03)	1.5×10^{-06} (3.1×10^{-07})	0.2 (0.04)	NA NA	NA NA
Subsurface Soil						
Ingestion	NA	NA	NA	NA	1.7×10^{-06}	0.33
Dermal Contact	NA	NA	NA	NA	5.8×10^{-07}	0.42
Subtotal	NA	NA	NA	NA	2.2×10^{-06}	NA
Surface Soil - PAH Hot Spot						
Ingestion	7.8×10^{-06} (1.7×10^{-06})	0.04 (0.02)	1.5×10^{-05} (3.3×10^{-06})	0.1 (0.04)	NA NA	NA NA
Dermal Contact	1.6×10^{-04} (1.3×10^{-05})	0.5 (0.1)	2.0×10^{-04} (1.5×10^{-05})	0.6 (0.1)	NA NA	NA NA
Subtotal	1.7×10^{-04} (1.5×10^{-06})	0.5 (0.1)	2.2×10^{-04} (1.8×10^{-06})	0.7 (0.1)	NA NA	NA NA

TABLE 2-12 (Continued)

INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES
FOR CURRENT POTENTIAL HUMAN RECEPTORS
RME AND CENTRAL TENDENCY VALUES
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Medium/Pathway	Current Potential Receptors [1]					
	Adult Trespasser		Adolescent Trespasser (7-15 yrs.)		Construction Worker	
	ICR	HI	ICR	HI	ICR	HI
Surface Water						
Ingestion	NA (NA)	0.02 (0.02)	NA (NA)	0.04 (0.03)		
Dermal Contact	NA (NA)	0.04 (0.03)	NA (NA)	0.04 (0.03)		
Subtotal	NA (NA)	0.06 (0.05)	NA (NA)	0.08 (0.06)		
Sediment						
Ingestion	2.5×10^{-07} (8.3×10^{-08})	0.01 (<0.01)	4.7×10^{-07} (1.6×10^{-07})	0.02 (0.01)		
Dermal Contact	8.8×10^{-07} (1.1×10^{-07})	0.05 (0.01)	1.1×10^{-06} (1.3×10^{-07})	0.06 (0.01)		
Subtotal	1.1×10^{-06} (1.9×10^{-07})	0.06 (0.01)	1.6×10^{-06} (2.9×10^{-07})	0.08 (0.02)		

Notes:

(1) Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{-06} to 1.0×10^{-04} and target HI value of 1.0). Values not in parentheses represent RME values. Values in parentheses represent central tendency risks.

RME - Reasonable Maximum Exposure
NA - Not Applicable
ICR - Incremental Lifetime Cancer Risk
HI - Hazard Index

TABLE 2-13

INDIVIDUAL CONTAMINANT RISK VALUES FOR
SURFACE SOIL - CURRENT POTENTIAL HUMAN RECEPTORS
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Medium/Pathway	Chemical	Current Potential Receptors[1]			
		Adolescent Trespasser		Adolescent Trespasser (7-15 yrs.)	
		ICR	HI	ICR	HI
Surface Soil - PAH Hot Spot					
Ingestion	Carbazole	6.49×10^{-09}	--	1.20×10^{-08}	--
	Benzo(a)anthracene	5.90×10^{-07}	--	1.10×10^{-06}	--
	Benzo(b)fluoranthene	6.60×10^{-07}	--	1.20×10^{-06}	--
	Benzo(k)fluoranthene	2.00×10^{-08}	--	3.80×10^{-06}	--
	Benzo(a)pyrene	5.20×10^{-06}	--	9.80×10^{-06}	--
	Indeno(1,2,3-cd)pyrene	3.10×10^{-07}	--	5.90×10^{-07}	--
	Dibenzo(a,h)pyrene	7.50×10^{-07}	--	1.40×10^{-06}	--
	Aluminum	--	0.0028	--	0.0053
	Arsenic	2.30×10^{-07}	0.0089	4.30×10^{-07}	0.017
	Beryllium	6.70×10^{-08}	0.000055	1.30×10^{-07}	0.001
	Iron	--	0.0075	--	0.014
	Manganese	--	0.019	--	0.036
	Vanadium	--	0.0057	--	0.011
Surface Soil - PAH Hot Spot					
Dermal Contact	Carbazole	1.40×10^{-07}	--	1.70×10^{-07}	--
	Benzo(a)anthracene	1.30×10^{-05}	--	1.65×10^{-05}	--
	Benzo(b)fluoranthene	1.45×10^{-05}	--	1.70×10^{-05}	--
	Benzo(k)fluoranthene	4.20×10^{-07}	--	5.20×10^{-07}	--
	Benzo(a)pyrene	1.10×10^{-04}	--	1.40×10^{-06}	--
	Indeno(1,2,3-cd)pyrene	6.60×10^{-06}	--	8.20×10^{-06}	--
	Dibenzo(a,h)pyrene	1.60×10^{-05}	--	2.00×10^{-05}	--
	Aluminum	--	0.015	--	0.0186
	Arsenic	2.50×10^{-07}	0.00989	3.20×10^{-07}	0.0123
	Beryllium	1.10 x 10-06	0.00093	1.40×10^{-06}	0.00116
	Iron	--	0.0397	--	0.0494
	Manganese	--	0.408	--	0.506
	Vanadium	--	0.0301	--	0.0374
Surface Soil - PAH Hot Spot Subtotal		1.7×10^{-06}	0.5	2.2×10^{-04}	0.7

Notes:

[1] Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{-06} to 1.0×10^{-04} and target HI value of 1.0).

ICR - Incremental Cancer Risk RME - Reasonable Maximum Exposure
HI - Hazard Index

TABLE 2-14

**INCREMENTAL CANCER RISK AND HAZARD INDEX VALUES
FOR FUTURE POTENTIAL HUMAN RECEPTORS
RME AND CENTRAL TENDENCY VALUES
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA**

Pathway	Future Potential Receptors[1]			
	Residential Adults		Residential Children (1-6 yrs.)	
	ICR	HI	ICR	HI
Surface Soil - Site 3 Proper				
Ingestion	4.4×10^{-06} (4.5×10^{-07})	0.1 (0.03)	1.0×10^{-05} (2.8×10^{-06})	0.99 (0.1)
Dermal Contact	1.4×10^{-05} (2.6×10^{-06})	0.4 (0.14)	6.1×10^{-06} (3.4×10^{-06})	0.6 (0.2)
Subtotal	1.8×10^{-05} (3.1×10^{-06})	0.5 (0.2)	1.6×10^{-05} (6.2×10^{-06})	1.6 (0.3)
Surface Soil - PAH Hot Spot				
Ingestion	2.3×10^{-04} (1.0×10^{-04})	0.2 (0.2)	5.4×10^{-04} (8.0×10^{-05})	2.0 (0.7)
Dermal Contact	2.4×10^{-03} (1.0×10^{-03})	1.2 (1.2)	1.0×10^{-03} (2.6×10^{-04})	2.2 (1.3)
Subtotal	2.6×10^{-03} (1.1×10^{-03})	1.4 (1.4)	1.5×10^{-03} (3.4×10^{-04})	4.2 (2.0)
Surface Water				
Ingestion	NA (NA)	<0.01 (0.004)	NA (NA)	0.03 (0.02)
Dermal Contact	NA (NA)	0.01 (0.01)	NA (NA)	0.05 (0.01)
Subtotal	NA (NA)	0.01 (0.01)	NA (NA)	0.05 (0.03)
Sediment				
Ingestion	8.3×10^{-07} (1.0×10^{-07})	0.01 (0.002)	1.9×10^{-06} (6.5×10^{-07})	0.1 (0.02)
Dermal Contact	1.5×10^{-06} (7.0×10^{-08})	0.01 (0.002)	6.5×10^{-07} (7.6×10^{-08})	0.02 (<0.01)
Subtotal	2.3×10^{-06} (1.7×10^{-07})	0.02 (0.004)	2.6×10^{-06} (7.3×10^{-07})	0.12 (0.02)

Notes:

(1) Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{-06} to 1.0×10^{-04} and target HI value of 1.0). Values not in parentheses represent RME values. Values in parentheses represent central tendency risks. ICR - Incremental Lifetime Cancer Risk. HI-Hazard Index. RME - Reasonable Maximum Exposure.

TABLE 2-15

INDIVIDUAL CONTAMINANT RISK VALUES FOR SURFACE SOIL - FUTURE POTENTIAL HUMAN RECEPTORS SITE 3 NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

Medium/Pathway	Contaminant	Future Potential Receptors[1]			
		Residential Adult		Residential Children (1-6 yrs.)	
		ICR	HI	ICR	HI
Surface Soil -Site 3 Proper					
Ingestion	Benzo(a)pyrene	5.49×10^{-07}	--	1.28×10^{-06}	--
	Aluminum	--	0.008		0.075
	Antimony	--	0.017		0.16
	Arsenic	2.54×10^{-06}	0.016	5.92×10^{-06}	0.15
	Beryllium	1.27×10^{-06}	0.00017	2.97×10^{-06}	0.0016
	Iron	--	0.053	--	0.5
	Manganese	--	0.011	--	0.1
Surface Soil -Site 3 Proper					
Dermal Contact	Benzo(a)pyrene	5.81×10^{-06}	--	2.57×10^{-06}	--
	Aluminum	--	0.021	--	0.038
	Antimony	--	0.045	--	0.079
	Arsenic	4.53×10^{-06}	0.029	2.0×10^{-06}	0.052
	Beryllium	3.37×10^{-06}	0.0046	1.49×10^{-06}	0.000815
	Iron	--	0.14	--	0.25
	Manganese	–	0.12	--	0.21
Surface Soil - Site 3 Proper Total		1.8×10^{-05}	0.5	1.6×10^{-05}	1.6
Surface Soil - PAH Hot Spot					
Ingestion	Carbazole	1.89×10^{-07}	--	4.41×10^{-07}	--
	Benzo(a)anthracene	1.75×10^{-05}	--	4.07×10^{-05}	--
	Benzo(b)fluoranthene	1.92×10^{-05}	--	4.49×10^{-05}	--
	Benzo(k)fluoranthene	5.85×10^{-07}	--	1.36×10^{-06}	--
	Benzo(a)pyrene	1.52×10^{-06}	--	3.55×10^{-04}	--
	Indeno(1,2,3-cd)pyrene	9.20×10^{-06}	--	2.15×10^{-05}	--
	Dibenzo(a,h)anthracene	2.19×10^{-05}	--	5.12×10^{-05}	
	Aluminum	--	0.014	--	0.13
	Arsenic	6.69×10^{-06}	0.0430.0	1.56×10^{-05}	0.4
	Beryllium	1.98×10^{-06}	0.00027	4.62×10^{-06}	0.0025
	Iron	--	0.037	--	0.34
	Manganese	--	0.09	--	0.84
	Vanadium	--	0.028	--	340.26

TABLE 2-15 (Continued)

INDIVIDUAL CONTAMINANT RISK VALUES FOR
SURFACE SOIL - FUTURE POTENTIAL HUMAN RECEPTORS
SITE 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Medium/*Pathway	Contaminant	Future Potential Receptors[1]			
		Residential Adult		Residential Children (1-6 yrs.)	
		ICR	HI	ICR	HI
Surface Soil - PAH Hot Spot					
Dermal Contact	Carbazole	2.00×10^{-06}	--	8.84×10^{-07}	--
	Benzo(a)anthracene	1.85×10^{-04}	--	8.17×10^{-05}	--
	Benzo(b)fluoranthene	2.04×10^{-06}	--	9.01×10^{-05}	--
	Benzo(k)fluoranthene	6.20×10^{-06}	--	2.74×10^{-06}	--
	Benzo(a)pyrene	1.61×10^{-03}	--	7.12×10^{-06}	--
	Indeno(1,2,3-cd)pyrene	9.75×10^{-05}	--	4.31×10^{-05}	--
	Dibenzo(a,h)anthracene	2.33×10^{-04}	--	1.03×10^{-04}	--
	Aluminum	--	0.037	--	0.065
	Arsenic	1.19×10^{-05}	--	5.28×10^{-06}	0.14
	Beryllium	5.24×10^{-04}	0.00071	2.32×10^{-06}	0.0013
	Iron	--	0.097	--	0.17
	Manganese	--	0.96	--	1.7
	Vanadium	--	0.074	--	0.13
Surface Soil - PAH Hot Spot Total		2.6×10^{-03}	1.4	1.5×10^{-03}	4.2

Notes:

[1]Shaded values in table represent exceedences of USEPA acceptable risk criteria (i.e., target ICR range of 1.0×10^{-06} to 1.0×10^{-04} and target HI value of 1.0).

ICR - Incremental Cancer Risk
HI - Hazard Index

2.6.2 Ecological Risk Assessment Summary

The objective of the ecological RA was to determine whether past operations at Sites 1 and 3 have adversely affected the ecological integrity of terrestrial and aquatic communities. Tables 2-16 through 2-20 present the ecological COPCs for Sites 1 and 3. Results of the ecological RA are presented below.

2.6.2.1 Site Terrestrial Ecological Risk

Potential ecological risks were evaluated in the terrestrial and aquatic environments at Site 1. Note that the aquatic habitat associated with this site is discussed with Site 3 in Section 2.6.2.3. Potential terrestrial receptors considered in the ecological RA for Site 1 are soil fauna, soil flora, American robins, American woodcocks. marsh wrens, red-tailed hawks, deer mice, short-tailed shrews, and meadow voles. The terrestrial receptors were selected to represent various trophic levels. Potential risks to the soil flora and fauna community were evaluated by a comparison of site concentrations to toxicity benchmark values established for flora, soil invertebrates, earthworms, microorganisms, and micro processes. Robins, woodcocks, marsh wrens, hawks, mice, shrews, and voles were evaluated through conservative modeling of potential contaminant uptake. Contaminant uptake was then compared with literature No Observable Adverse Effect Level (NOAELs) or Lowest Observable Adverse Effect Levels (LOAELs).

Based on a screening of soil concentrations against flora/fauna toxicity values, the terrestrial environment at Site 1 is potentially impacted by soil concentrations of aluminum, chromium, iron, lead, and vanadium. In addition, receptor models calculated for Site 1 demonstrated risks from surface soil concentrations of aluminum, chromium, iron, lead, and vanadium. Site 1 surface soil concentrations of aluminum, chromium, iron, and vanadium were detected below the range of background surface soil concentrations. As a result, these contaminants were not retained as COPCs for further evaluation.

Site 1 surface soil concentrations of lead were detected above background concentrations. Only one soil sample (62.3 mg/kg) collected at Site 1 exceeded the maximum background lead concentration (43.1 mg/kg); therefore, lead was not considered as a Site 1 soil COPC.

TABLE 2-16

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 1
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
SENUVOLATILES (ug/kg)					
BENZO (a) ANTHRACENE	6/21	47J - 400	350 - 480	170.81	NA
BENZO (a) PYRENE	6/21	69J - 380J	350 - 480	170.48	NA
BENZO (b) FLOURANTHENE	9/21	48J - 690	350 - 480	183.38	NA
BENZO (g.h,i) PERYLENE	7/21	42J - 260J	350 - 480	155.76	NA
BENZO (k) FLOURANTHENE	6/21	43J - 260J	350 - 480	162.29	NA
BUTYLBENZYLPHTHALATE	2/21	40J - 240J	350 - 480	184.76	NA
CHRYSENE	7/21	56J - 480	350 - 480	174.57	NA
FLOURANTHENE	8/21	60J - 390	350 - 480	176.86	NA
INDENO (1, 2.3 - cd) PYRENE	7/21	49J - 300J	350 - 480	161.10	NA
PHERANTHRENE	1/21	200J	350 - 480	190.00	NA
PYRENE	8/21	52J - 470	350 - 480	179.10	NA
NITRAMINES (ug/kg)					
2-,4-DINITROTOLUENE	1/21	68J	NA - NA	NA	NA
INORGANICS (mg/kg)					
ALUMINUM	21/21	1,930 - 11,200	NA - NA	4,811.90	1,960 - 24,100
BERYLLIUM	15/21	0.21- 0.55	0.14 - 0.15	0.25	0.23J - 0.93J
CHROMIUM	21/21	3.41K - 12.4	NA - NA	6.50	2.6 - 33.5
IRON	21/21	2,510 - 11.700	NA - NA	5,545.71	1.440 - 46,400
LEAD	21/21	2.8 - 62.3K	NA - NA	9.62	6.4 - 43.1
NICKEL	16/21	2.3K - 7.3K	1.9 - 2.4	3.43	3.8J - 12.5
VANADIUM	21/21	5.6 - 20	NA - NA	10.10	6.1 J - 64.7
ZINC	21/21	4.4K - 43.5	NA - NA	15.90	3.2KJ - 48.4

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable; J - estimated value, K - estimated biased high

TABLE 2-17

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - PROPER
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND(l)
SEMIVOLATILES (ug/kg)					
BENZO(A)ANTHRACENE	1/15	160J	NA - NA	193.00	NA
BENZO(B)FLOURANTHENE	1/15	220J	NA - NA	199.67	NA
BENZO(A) PRYENE	1/15	160J	NA - NA	195.67	NA
CHRYSENE	1/15	170J	360 - 440	196.33	NA
FLOURANTHENE	1/15	140J	360 - 440	194.33	NA
PHENANTHRENE	1/15	220J	360 - 440	199.67	NA
PYRENE	1/15	240	360 - 440	201.00	NA
INORGANICS (mg/kg)					
ALUMINUM	15/15	985 - 11,800	NA - NA	4,547.00	1.960 - 24,100
ANTIMONY	2/15	4.6L - 16.8L	3.1 - 5.2	3.20	9.2L - 11L
BERYLLIUM	14/15	0.20 - 1.5	0,34 - 0.58	0.49	0.23J - 0.93J
CHROMIUM	15/15	2.9K - 31.6K	NA - NA	10.36	2.6 - 33.5
CYANIDE	1/15	0.89	0.42 - 0.60	0.29	ND
IRON	15/15	2,460 - 23, 800	NA - NA	8,331.33	1.440 - 46,400
LEAD	15/15	3.1 - 74.3	NA - NA	15.98	6.4 - 43.1
MANGANESE	15/15	6.7 - 667	NA - NA	121.29	7.6L - 491
MERCURY	2/15	0.05 - 0.11	0.04 - 0.06	0.03	0.05J
NICKEL	11/15	2.0K - 8.9	1.8 - 3.0	3.66	3.8J - 12.5
THALLIUM	1/15	0.23K	0.15 - 0.35	0.13	ND
VANADIUM	15/15	5.3 - 37.7	NA - NA	15.87	5.2J - 64.7
ZINC	13/15	3.7L - 203	10.5B - 11.1B	31.57	3 2KJ - 48.4

Notes:
(1)Data considers both station-wide and Anthropogenic Background Samples
NA - Not Applicable
NO - Not Detected
J - estimated value K - estimated biased high L - estimated biased low

TABLE 2-18

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - AOC
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND(l)
SEMIVOLATILES (ug/kg)					
ACENAPHTHENE	4/6	260J - 18,000	380 - 8,100	3,650.00	NA
ANTHRACENE	6/6	65J - 47,000	NA - NA	10,743.67	NA
BENZO(A)ANTHRACENE	6/6	160J - 92,000	NA - NA	21,008.33	NA
BENZO(B)FLOURANTHENE	6/6	120J - 98,000	NA - NA	24,015.00	NA
BENZO(A) PRYENE	6/6	170J - 77,000	NA - NA	19,050.00	NA
BENZO(g,h,i)PERYLENE	6/6	110J - 41,000	NA - NA	10,265.00	NA
BENZO(K)FLOURANTHENE	6/6	130J - 37,000	NA - NA	6,755.00	NA
CARBAZOLE	6/6	43J - 37,000	NA - NA	8,087.67	NA
CHRYSENE	6/6	230J - 87,00	NA - NA	21,210.00	NA
DIBENZO(a,h)ANTHRACENE	5/6	41J - 12,000	410 - 410	2,516.00	NA
DIBENZOFURAN	4/6	190J -14,000	390 - 410	2,833.33	NA
FLOURANTHENE	6/6	370J - 190,000	NA - NA	43,210.00	NA
FLOURENE	4/6	290J - 22,000	390 - 410	4,363,33	NA
INDENO(1,2,3-cd)PYRENE	6/6	120J - 147,000	NA - NA	11,413.33	NA
2-METHYLNAPTHALENE	3/6	57J - 4,000J	390 - 410	842.83	NA
NAPTHALENE	4/6	62J - 7,300	390 - 410	1,424 67	NA
PHENANTHRENE	6/6	250J - 200,000	NA - NA	43,260.00	NA
PYRENE	6/6	290J - 160,000	NA - NA	36,671.67	NA

TABLE 2-18 (continued)

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE SOIL SAMPLE ANALYSIS
SITE 3 - AOC
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND(l)
INORGANICS (mg/kg)					
ALUMINUM	1/1	10,000	NA - NA	NA	19,600 - 24,100
BERYLLIUM	1/1	0.98	NA - NA	NA	0.23J - 0.93J
CHROMIUM	1/1	16	NA - NA	NA	2.6 - 33.5
COPPER	1-Jan	10.9	NA - NA	NA	1.2J - 24.4
IRON	1/1	8,040	NA - NA	NA	1,440 - 46,400
LEAD	1/1	59.4	NA - NA	NA	6.4 - 43.1
MANGANESE	1/1	1.580	NA - NA	NA	7.6L - 491
MERCURY	1/1	0.15	NA - NA	NA	0.05J
NICKEL	1/1	21.5	NA - NA	NA	3.8.J - 12.5
VANADIUM	1/1	142	NA - NA	NA	5.2J - 64.7
ZINC	1/1	180	NA - NA	NA	3.2KJ - 48.4

Notes:
(1) Data considers both Station-wide and Anthropogenic Background Samples
NA - Not Applicable
ND - Nondetect
J - Estimated value
K - Estimated biased high
L - Estimated biased low

TABLE 2-19

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SURFACE WATER SAMPLE ANALYSIS
SITES 1 AND 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND (1)
INORGANICS (ug/kg)					
ALUMINUM	4/4	1,110 - 2,420	NA - NA	1,677.50	171J - 5,600
COPPER	4/4	7.4K - 9.1K	NA - NA	8.05	5.6.1 - 6.7J
IRON	4/4	1,220.J - 3,250J	NA - NA	2,032.50	289J - 6,650
MANGANESE	4/4	20.8 - 54.9J	NA - NA	44.10	33.1 - 379
ZINC	4/4	10.4K - 20.1 K	NA - NA	15.18	7.9J - 20.2

Notes:
(1) From Background Report (Baker,1995)
NA - Not Applicable
J -Estimated value
K - Estimated biased high

TABLE 2-20

SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN
FROM SEDIMENT SAMPLE ANALYSIS
SITES1 AND 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN VIRGINIA

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	RANGE OF DETECTED LIMITS	ARITHMATIC MEAN	RANGE OF STATION BACKGROUND(l)
INORGANICS (mg/kg)					
ALUMINUM	10/10	434 - 21,100	NA - NA	10,899.30	1,510 - 40,500
ARSENIC	8/10	0.63 - 15.4.1	0.30 - 0.37	8.55	1.4J - 13.1
CADMIUM	1/10	1.7	0.68 - 2.4	1.70	ND
COBALT	7/10	0.46 - 8.9	0.43 - 0.88	6.51	3.8J - 15J
IRON	10/10	577 - 39,100	NA - NA	22,812 70	3,060 - 46,000
LEAD	10/10	0.91 - 56.8	NA - NA	19.88	3.4 - 51.6
MANGANESE	10/10	3.7 - 379	NA - NA	171.15	7.4 - 1,980
NICKEL	6/10	11.8 - 21	0.21 - 2.4	17.25	9.3K - 55.2
VANADIUM	10/10	0.79 - 51.8	NA - NA	28.48	4J - 202J

Notes:
(1) From Background Report (Baker,1995)
NA - Not Applicable
ND - Not Detected
J - Estimated value
K - Estimated biased high

2.6.2.2 Site 3 Terrestrial Ecological Risk

Potential ecological risks were evaluated in the terrestrial environment at Site 3. Two separate ecological RAs were conducted for Site 3; one for a potential hot spot of PAH-contaminated soil and one for the remaining area of Site 3 (also termed Site 3 Proper). The aquatic habitat associated with Site 3 is discussed in Section 2.6.2.3. Potential terrestrial receptors considered in the ecological RA for Site 3 included: soil fauna, soil flora, American robins, American woodcocks, marsh wrens, red-tailed hawks, deer mice, short-tailed shrews, and meadow voles. The terrestrial receptors were selected to represent various trophic levels. Potential risks to the soil flora and fauna community were evaluated by a comparison of site concentrations to toxicity benchmark values established for flora, soil invertebrates, earthworms, microorganisms, and micro processes. Robins, woodcocks, marsh wrens, hawks, mice, shrews, and voles were evaluated through conservative modeling of potential contaminant uptake. Contaminant uptake was then compared with literature NOAELs or LOAELs.

Site 3 Proper

The terrestrial flora and fauna environment in Site 3 Proper could be adversely influenced by soil concentrations of aluminum, antimony, chromium, iron, lead, manganese, mercury, thallium, vanadium, and zinc. Terrestrial receptor models displayed risks from surface soil concentrations of aluminum, antimony, chromium, iron, lead, and vanadium. The surface soil concentrations of aluminum, antimony, chromium, iron, and vanadium were detected in Site 3 Proper at concentrations similar to background concentrations. The surface soil concentrations of lead, manganese, mercury, thallium, and zinc in Site 3 Proper were detected above background concentrations.

Soil concentrations of lead (maximum site concentration = 74.3 mg/kg; background maximum concentration = 43.1 mg/kg) and manganese (maximum site concentration = 667 mg/kg; background maximum concentration = 491 mg/kg) were not detected at values significantly greater than background ranges. Mercury concentrations were detected in two out of fifteen samples. One sample (mercury = 0.1 mg/kg) exceeded the maximum background concentration of mercury (0.05 mg/kg). Thallium was detected in one sample out of the fifteen collected from Site 3 Proper and was not detected in the background surface soil. Zinc concentrations exceeded background concentrations at two locations. Of the two zinc exceedances of background (203 mg/kg and 51.3 mg/kg), only one sample was detected significantly greater than background (background 48.4 mg/kg). Due to background concentrations and sporadic detections, the inorganics detected in the soil collected from Site 3 Proper were retained as COPCs, but the concentrations detected did not warrant further consideration for remediation purposes.

Site 3 - PAH-contaminated Soil Hot Spot

The terrestrial flora and fauna community in the PAH hot spot could be adversely influenced by soil concentrations of PAHs, aluminum, chromium, iron, lead, manganese,

mercury, vanadium, and zinc. Receptor model species may be adversely impacted by surface soil concentrations of PAHs, aluminum, chromium, copper, iron, lead, manganese, mercury, vanadium, and zinc. The highest concentrations of PAHs were collected from the original sample collected in the PAH hot spot (3SS10) and the soil sample collected adjacent to the original sample (3SS10C). Aluminum, chromium, copper, and lead were detected in the hot spot area at concentrations similar to background concentrations. Surface soil concentrations were greater than background ranges for concentrations of manganese, mercury, vanadium, and zinc. The inorganic terrestrial risk is based on one surface soil sample collected from the PAH hot spot. The PAHs were determined to be the primary COPCs in this area; therefore, the inorganics were not retained for further consideration.

2.6.2.3 Sites 1 and 3 Aquatic Ecological Risk

Potential aquatic receptors considered in the Sites 1 and 3 ecological RA included: sediment benthic macroinvertebrates, fish (including the largemouth bass), bullfrogs, and great blue herons. The aquatic receptors were selected to represent various trophic levels. Sediment benthic macroinvertebrates were evaluated by comparison to available benchmarks. Largemouth bass, bullfrogs, and great blue herons were evaluated using conservative uptake modeling.

The aquatic environment could be adversely affected by surface water concentrations of aluminum, copper, and iron. Aluminum, copper, and iron at Site 1 and 3 were detected at concentrations similar to background. Therefore, no COPCs detected in the surface water were retained for evaluation.

Based on slight exceedances of toxicity benchmarks, sediment concentrations of cadmium, iron, and manganese potentially may adversely affect the benthic macroinvertebrate community at Sites 1 and 3. In addition, other aquatic receptors inhabiting Site 1 and 3 could be adversely impacted by aluminum, iron, and lead, as indicated by the receptor models. Sediment concentrations of aluminum, iron, lead, and manganese are below background upper confidence level (UCL) concentrations. Sediment concentrations of cadmium were detected above background concentrations. Cadmium concentrations (maximum concentration = 1.7 mg/kg) were detected below the effects range-medium (ER-M) value (99.6 mg/kg). Inorganics in the sediment were not retained as COPCs.

2.6.3 Summary of Risk Assessment Results

At Site 1, arsenic detected in the soil significantly contributed to human health risk values in excess of the generally acceptable target risk range of 1.0×10^{-6} to 1.0×10^{-4} and HI values above 1.0. The arsenic concentrations were above the maximum Station-wide background level. These elevated levels of arsenic were detected in the surface soil at a hot spot located near monitoring wells 1GW12A and GW12B (**Figure 2-3**).

At Site 3, several carcinogenic PAHs detected in the soil significantly contributed to unacceptable human health risk values. Both carcinogenic and non-carcinogenic PAHs detected in the surface soil produced risks in the terrestrial receptor models. The elevated levels of PAHs were detected in a limited hot spot area in the surface soil near surface soil sample location 3SS10. The PAHs retained as COPCs included: acenaphthene, anthracene, benzo(a)anthracene, benzo(a)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzo(a)pyrene, carbazole, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3)pyrene, naphthalene, and phenanthrene.

Based on the results of the baseline human health and ecological RAs, it was determined that the arsenic-contaminated soil hot spot at Site 1 and the PAH-contaminated soil hot spot at Site 3 will require remediation to be protective of human health and the environment. Arsenic (Site 1) and PAHs (Site 3) were determined to be the contaminants of concern (COCs) for these sites. Remediation levels (RLs) of 63 mg/kg and 10 mg/kg were derived in the FS for arsenic at Site 1 and carcinogenic PAHs at Site 3, respectively. These RLs are protective of both human health and the environment.

2.7 Description of Remedial Alternatives

The DoN considered a focused range of potential remedial action alternative (RAAs) for the remediation of Sites 1 and 3:

- Site 1 RAA 1: No Action
- Site 1 RAA 2: Soil Cover and Surface Debris Removal
- Site 1 RAA 3: Surface Debris Removal, Excavation with Off-Site Disposal, Soil Cover, and Institutional Controls

- Site 3 RAA 1: No Action
- Site 3 RAA 2: Institutional Controls and Debris Removal
- Site 3 RAA 3: Soil Excavation with On-Site Treatment, Debris Removal, and Institutional Controls
- Site 3 RAA 4: Soil Excavation with Off-Site Disposal, Debris Removal, and Institutional Controls

2.7.1 Site 1 Remedial Action Alternatives

2.7.1.1 Site 1 RAA 1: No Action

Under the No Action RAA, arsenic-contaminated soil and surficial debris at Site 1 will remain in place. No remedial efforts will be conducted to reduce the arsenic contamination exceeding the remediation level of 63 mg/kg, to eliminate surface debris, or to restore the eroded portions of the existing soil cover at the site. No actions will be taken to reduce human and environmental contact with the site contaminants. This RAA was evaluated to provide a baseline for comparison to other RAAs.

- Estimated Capital Cost: $0
- Estimated Annual Operation and Maintenance (O&M) Costs: $0
- Estimated Net Present Worth (NPW): $0
- Estimated Implementation Time: Immediate

2.7.1.2 Site 1 RAA 2: Soil Cover and Surface Debris Removal

RAA 2 for Site 1 includes the restoration of the soil cover currently over Site 1 and the removal of surface debris. No specific remediation will be directed to the arsenic-contaminated soil. The existing soil cover at Site 1 contains several small depressions and eroded areas. It is estimated that 3,200 cubic yards of soil will be required to restore the grade and provide proper drainage to Site 1. The cover area includes approximately 3.3 acres, with an average cover depth of two feet. A topographic land survey will be conducted prior to the installation of the soil cover to identify the depressions and eroded areas that will be addressed. The soil cover will consist of material that is similar to that of the existing cover, and will be obtained from the Station's borrow pit. Six inches of topsoil will be installed on the restored cover area. Upon completion of the soil cover placement, the site will be vegetated with native grasses. Several area of surface debris have been identified near Site 1, along the ravine and bank leading toward Indian Field Creek. Surface debris at this site consists of buckets, drums, banding, construction debris, etc. Additional surface debris has also been noted within the Site 1 area. Surface debris will be collected and disposed off-site or recycled. Since hazardous substances will remain at Site 1 under this RAA, Section 121(c) of CERCLA, 42 U.S.C § 9621 (c), requires that this remedial action be reviewed no less often than every five years after its initiation to ensure the protection of human health and the environment. Operation and maintenance activities will include a biannual inspection of the soil cover.

- Estimated Capital Cost: $161,000
- Estimated Annual O&M Cost: $5,500
- Estimated NPW: $245,000
- Estimated Implementation Time: 180 days

2.7.1.3 Site 1 RAA 3: Surface Debris Removal, Excavation with Off-Site Disposal, Soil Cover, and Institutional Controls

RAA 3 includes the removal and disposal and/or recycling of surface debris, excavation and off-site disposal of the arsenic-contaminated soil hot spot, restoration of the soil cover currently over Site 1, and implementation of institutional controls. Prior to excavation, the soil will be tested to determine if it is hazardous by characteristic in accordance with the RCRA regulations at 40 C.F.R. Part 261, Subpart C. Based on the test results, the excavated soil will be stored appropriately on-site prior to being transported off-site and an appropriate off-site disposal facility will be selected. All arsenic-contaminated soil exceeding the remediation level of 63 mg/kg (i.e., the arsenic hot spot) will be excavated.

Based on existing sampling results, an estimated 105 cubic yards of arsenic-contaminated soil will be removed. During the excavation activities, a minimum of 10 confirmatory soil samples will be collected and analyzed for arsenic to determine the extent of contamination. All excavated soil will be transported to a permitted off-site disposal facility, as discussed above. The excavation area, together with existing depressions and erosion areas in the existing soil cover, will be backfilled with clean soil fill from the WPNSTA's borrow pit. A topographic land survey will be conducted prior to the restoration of the soil cover to identify the depressions and eroded areas that need to be addressed. The backfilled areas will be covered with six inches of topsoil and revegetated with native grasses. An estimated 3,300 cubic yards of clean soil fill and 800 cubic yards of topsoil will be required to fill the excavation and restore the soil cover at Site 1. Institutional controls, in the form of land use controls, will be implemented at Site 1. Since hazardous substances will remain at Site 1 under this RAA, Section 121(c) of CERCLA, 42 U.S.C.§ 9621 (c), requires that such remedial action be reviewed no less often than every five years after its initiation to ensure the protection of human health and the environment.

- Estimated Capital Cost: $190,000
- Estimated Annual O&M Cost: $5,500
- Estimated NPW: $270,000
- Estimated Implementation Time: 180 days

2.7.2 Site 3 Remedial Action Alternatives

2.7.2.1 Site 3 RAA 1: No Action

Under the No Action RAA for Site 3, contaminated soil and surficial debris will remain in place. No remedial efforts will be conducted to reduce the PAH-contaminated soil exceeding the remediation level of 10 mg/kg total carcinogenic PAHs or to eliminate surface debris. No actions will be taken to reduce human and environmental contact with the site contaminants. This RAA was evaluated to provide a baseline for comparison to other RAAs.

- Estimated Capital Cost: $0
- Estimated Annual O&M Costs: $0
- Estimated NPW: $0
- Estimated Implementation Time: Immediate

2.7-2.2 Site 3 RAA 2: Institutional Controls and Debris Removal

The Site 3 RAA 2 combines institutional controls with the removal of surficial debris from Site 3. It is noted that this RAA does not include groundwater monitoring (which will be addressed as a separate operable unit), as originally presented in the Proposed Remedial

Action Plan (PRAP). In addition, remediation of the PAH-contaminated soil detected at Site 3 is not included in this alternative. The surface debris will be removed from Site 3 and then disposed off-site or recycled, if applicable. Several areas of surface debris have been identified around and within Site 3, along with debris noted near the dirt access road and along the bank leading toward Indian Field Creek. Institutional controls, in the form of land use controls will be implemented at Site 3. Since hazardous substances will remain at Site 3 under this RAA. Section 121(c) of CERCLA, 42 U.S.C. § 9261(c), requires that such remedial action be reviewed no less often then every five years after its initiation to ensure the protection of human health and the environment.

- Estimated Capital Cost: $94,000
- Estimated Annual O&M Costs: $0
- Estimated NPW: $94,000
- Estimated Implementation Time: 90 days

2.7.2.3 Site 3 RAA 3: Soil Excavation with On-Site Treatment, Debris Removal, and Institutional Controls

The Site 3 RAA 3 includes the excavation and on-site treatment of the PAH-contaminated soil exceeding the remediation level of 10 mg/kg total carcinogenic PAHs. An estimated 90 cubic yards of PAH-contaminated soil will be removed from the hot spot area measuring approximately 60 feet by 20 feet by 2 feet deep. A minimum of six confirmatory soil samples will be collected and analyzed for PAHs to determine the extent of contamination. All PAH-contaminated soil exceeding the remediation level of 10 mg/kg total carcinogenic PAHs will be excavated. The soil will be subjected to an on-site biological treatment process such as land farming, composting, or soil vapor extraction. Once treated, the soil will be tested for PAH concentrations and, if acceptable (below 10 mg/kg for total carcinogenic PAHs), will be redeposited at Site 3. If the total carcinogenic PAH concentrations in the treated soil are above 10 mg/kg, clean fill from the Station's borrow pit will be used for backfilling the excavated area. Upon completion of backfilling activities, the disturbed areas will be covered with six inches of topsoil and vegetated with native grasses. Assuming that the treated soil can be returned to the excavation, this RAA will require approximately 25 cubic yards of topsoil for final site restoration. All surface debris and debris encountered during the hot spot excavation will be disposed off-site or recycled. Institutional controls, in the form of land use controls, will be implemented at Site 3. Since hazardous substances will remain at Site 3 under this RAA, Section 121 (c) of CERCLA, 42 U.S.C.§9261(c), requires that such remedial action be reviewed no less often than every five years after its initiation to ensure the protection of human health and the environment.

- Estimated Capital Cost: $194,000
- Estimated Annual O&M Costs: $0
- Estimated NPW: $195,000
- Estimated Implementation Time: 90 days

2.7.2.4 Site 3 RAA 4: Soil Excavation with Off-Site Disposal. Debris Removal. and Institutional Controls

The Site 3 RAA 4 is similar to RAA 3, with the exception that the excavated soil will not be treated on-site. Under this RAA, PAH-contaminated soil exceeding the 10 mg/kg remediation level will be transported off-site to a permitted disposal facility. Prior to excavation, the soil will be tested to determine if the soil is hazardous by characteristic in accordance with the RCRA regulations at 40 C.F.R. Part 261, Subpart C. Based on the test results, the excavated soil will be stored appropriately on-site prior to being transported off-site and an appropriate off-site disposal facility will be selected. Based on existing sampling results, an estimated 90 cubic yards of PAH-contaminated soil will be removed from the hot spot area measuring approximately 60 feet by 20 feet by 2 feet deep. During the excavation activities, a minimum of six confirmatory soil samples will be collected and analyzed for PAHs to determine the extent of contamination. All PAH contaminated soil exceeding the remediation level of 10 mg/kg total carcinogenic PAHs will be excavated. The excavated areas will be backfilled with clean soil from the Station's borrow pit. The disturbed area will be covered with six inches of topsoil and vegetated with native grasses. Site restoration activities will require approximately 25 cubic yards of topsoil. In addition, all surface debris and debris encountered during the hot spot excavation will be disposed off-site or recycled. Institutional controls, in the form of land use controls, will be implemented at Site 3. Since hazardous substances will remain at Site 3 under this RAA, Section 121(c) of CERCLA, 42 U. S.C. § 962 1 (c), requires that such remedial action be reviewed no less often then every five years after its initiation to ensure the protection of human health and the environment.

- **!** Estimated Capital Cost: S154,500
- **!** Estimated Annual O&M Costs: $0
- **!** Estimated NPW: $155,000
- **!** Estimated Implementation Time: 90 days

2.8 Summary of the Comparative Analysis of Alternatives

As required by CERCLA, the set of RAAs developed for Sites 1 and 3 were evaluated against the nine criteria specified by USEPA (**Table 2-21**). This section and **Table 2-22** summarize the detailed analysis of each alternative with respect to each site.

TABLE 2-21

GLOSSARY OF EVALUATION CRITERIA
SITES 1 AND 3
WPNSTA YORKTOWN, YORKTOWN, VIRGINIA

- **Overall Protection of Human Health and the Environment** - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering, or institutional controls.

- **Compliance with ARARs/TBCs** - addresses whether or not an alternative will meet all the applicable or relevant and appropriate requirements (ARARs), other criteria to be considered (TBCs), or other federal and state environmental statutes and/or provide grounds for invoking a waiver.

- **Long-term Effectiveness and Permanence** - refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

- **Reduction of Toxicity, Mobility, or Volume Through Treatment** - refers to the anticipated performance of the treatment options that may be employed in an alternative.

- **Short-term Effectiveness** - refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period.

- **Implementability** - refers to the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the chosen solution.

- **Cost** - includes capital and operation and maintenance costs. For comparative purposes, provides present worth values.

- **State Acceptance** - indicates whether, based on its review of the RI and FS reports and the PRAP, the State concurs with, opposes, or has no comment on the selected alternative.

- **Community Acceptance** - will be assessed in the ROD following a review of the public comments received on the RI and FS reports, and the PRAP.

TABLE 2-22

SUMMARY OF DETAILED ANALYSIS
SITES 1 AND 3
WPNSTA YORKTOWN, YORKTOWN, VIRGINIA

Evaluation Criteria	Site 1 RAA 1: No Action	Site 1 RAA 2 Soil Cover and Surface Debris Removal	Site 1 RAA 3: Debris Removal, Excauvation, Off-Site Disposal, Soil Cover, Institutional Controls	Site 3 RAA 1 No Action	Site 3 RAA 2: Institutional Controls, Debris Removal	Site 3 RAA 3: Excauvation, On-Site Treatment, Debris Removal, Institutional Controls	Site 3 RAA 4: Excavation, Off-Site Disposal, Debris Removal, Institutional Controls
Overall Protectiveness	! No reduction in risk to human health and the environment	! Will eliminate direct exposure to arsenic-contaminated soil ! Prevents erosion of contaminated soil. ! Reduces perculation of surface water through contaminated soil. ! Does not treat contamination. ! Removes hazard of surface debris.	! Significant reduction in risk due to source removal ! Removes potential source of groundwater and surface water contamination. ! Does not treat contamination. ! Removes hazard of surface debris	! No reduction in risk to human health and the environment	! Will provide a slight reduction in risk to potential human receptors No reduction in risk to the environment ! Removes hazard of surface debris ! Does not treat contamination	! Significant reduction in risk by removal and treatment of PAH-contaminated soil ! Removes potential source of surface water and groundwater contamination ! Removes hazard of surface debris	! Significant reduction in risk due to source removal ! Removes potential source of surface water and ground water contamination ! Does not treat contamination ! Removes hazard of surface debris
Compliance with ARARs	! Will not meet all ARARs	! Will meet all ARARs	! Will meet all ARARs	! Will not meet all ARARs	! Will meet all ARARs	! Will meet all ARARs	! Will meet all ARARs
Long-Term Effectiveness and Permanence	! Not effective and permanent.	! If properly maintained, soil cover will be effective and permanent ! 5-year review required	! Effective and permanent because the contaminated soil is removed from the site. ! 5-year review required	! Not effective and permanent.	! Not effective and permanent ! 5-year review required	! Effective and permanent because the contaminated soil is treated ! 5-year review required	! Effective and permanent because the contaminated soil is removed from the site ! 5-year review required
! Reduction of Toxicity, Mobility, or Volume Through Treatment	! Will not reduce toxicity, mobility, or volume of contaminants through treatment	! Will not reduce toxicity, mobility, or volume of contaminants through treatment	! Will not reduce toxicity, mobility, or volume of contaminants through treatment.	! Will not reduce toxicity, mobility, or volume of contaminants through treatment	! Will not reduce toxicity, mobility, or volume of contaminants through treatment	! PAH-contaminated soil will be treated using biological methods	! Will not reduce toxicity, mobility, or volume of contaminants through treatment

TABLE 2-22 (Continued)

SUMMARY OF DETAILED ANALYSIS
SITES 1 AND 3
WPNSTA YORKTOWN, YORKTOWN, VIRGINIA

Evaluation Criteria	Site 1 RAA 1: No Action	Site 1 RAA 2 Soil Cover and Surface Debris Removal	Site 1 RAA 3: Debris Removal, Excauvation, Off-Site Disposal, Soil Cover, Institutional Control	Site 3 RAA 1 No Action	Site 3 RAA 2: Institutional Controls, Debris Removal	Site 3 RAA 3: Excauvation, On-Site Treatment, Debris Removal, Institutional Controls	Site 3 RAA 4: Excavation, Off-Site Disposal, Debris Removal, Institutional Controls
hort-Term Effectiveness	! No short-term effects on human health and the environment	! Risk to community and workers may increase due to fugitive dust caused by installation of soil cover. ! Minimal increases in risk to workers during debris removal	! Risk to community and workers may increase due to fugitive dust caused by excavation and by installation of soil cover. ! Possible risk to community during off-site transportation of arsenic-contaminated soil. ! Minimal increase in risk to workers during debris removal	! No short-term effects on human health and the environment.	! Minimal increase in risk to workers during debris removal	! Risk to community and workers may increase due to fugitive dust caused by excavation and biological treatment. ! Minimal increase in risk to workers during debris removal	! Risk to community and workers may increase due to fugitive dust caused by excavation ! Possible risk to community during off-site transportation of PAH-contaminated soil ! Minimal increase in risk to workers during debris removal.
Implementability	! No remedial activities planned- easily implemented	! Easy to construct and maintain soil cover ! Equipment and materials readily available.	! Routine construction operations. ! Equipment and materials readily available. ! Requires coordination with off-site disposal facility.	! No remedial activities planned -easily implemented	! Institutional controls are easily implemented ! equipment for debris removal readily available	! Uses proven method of biological treatment, but is more labor intensive and takes longer to implement than off-site disposal ! Routine construction operations. ! Equipment and materials readily available	! Is less labor intensive and takes less time to implement than on-site treatment ! Routine construction operations. ! Equipment and materials readily available ! Requires coordination with off-site disposal facility
Costs (NPW)	$0	$245,000	$270,000	$0	$94,000	$195,000	$155,000

2.8.1 Site 1 RAA Comparative Analysis

2.8.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

Evaluation of the overall protectiveness of alternatives focused on whether a specific alternative would achieve adequate protection of human health and the environment and how risks posed by each exposure pathway would be eliminated, reduced, or controlled through treatment, engineering, or institutional controls. The overall assessment of the level of protection includes the evaluations conducted under other criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

RAA 1 for Site 1, No Action, does not include measures to protect human health or the environment. RAA 2 provides limited protection to human health and the environment by the implementation of a soil cover, which will eliminate direct exposure to and prevent erosion of arsenic-contaminated soil. RAA 3 is the most protective of human health and the environment because it provides for the actual removal and disposal of the arsenic-contaminated soil from Site 1. Removal of the arsenic-contaminated soil will eliminate the risk of exposure and eliminate a potential source of groundwater and surface water contamination.

Compliance with ARARs:

This evaluation involved determining whether each alternative would meet all of the pertinent Federal and State ARARs (as identified in Section 2.11.2 of this ROD).

Each alternative was evaluated for compliance with applicable or relevant and appropriate Federal and State requirements. The evaluation summarized which requirements are applicable or relevant and appropriate to each alternative. The following items were considered for each alternative:

- Compliance with chemical-specific ARARs (e.g., ambient water quality criteria). This factor addresses whether the ARARs can be met, and, if not, whether a waiver may be appropriate.

- Compliance with location-specific ARARs (e.g., preservation of historic sites, regulations relative to activities near wetlands or floodplain, etc.). As with other ARAR-related factors, these involve consideration of whether the ARARs can be met or whether a waiver is appropriate.

- Compliance with action-specific ARARs (e.g., RCRA minimum technology standards). It must be determined whether ARARs can be met or must be waived.

Except for RAA1 (No Action), the RAAs for Site 1 will comply with all applicable location- and action-specific ARARs. The ARARs are identified in Section 2.11.2 of this ROD. There are no chemical-specific ARARs for arsenic-contaminated soil. The background concentration of arsenic was selected as the remediation level that is protective of both human health and the environment.

2.8.1.2 Primary Balancing Criteria

Long-Term Effectiveness and Permanence:

This criterion evaluated alternatives with respect to their long-term effectiveness and the degree of permanence. The primary focus of this evaluation was the residual risk that will remain at the sites and the effectiveness of the controls that will be applied to manage residual risks. The assessment of long-term effectiveness was made considering the following four factors:

- The magnitude of the residual risk to human and environmental receptors remaining from untreated waste or treatment residues at the completion of remedial activities.

- An assessment of the type, degree, and adequacy of long-term management (including engineering controls, institutional controls, monitoring, and operation and maintenance) required for untreated waste or treatment residues remaining at the site.

- An assessment of the long-term reliability of engineering and/or institutional controls to provide continued protection from untreated waste or treatment residues.

- The potential need for replacement of the remedy and the continuing need for repairs to maintain the performance of the remedy.

The long-term effectiveness and permanence of the No Action alternative are unknown. The No Action alternative includes no methods to monitor arsenic concentrations over time. RAA 2, Soil Cover and Surface Debris Removal, will provide a long-term and permanent cover over the arsenic hot spot as long as the cover is maintained properly. RAA 3 will be the most permanent and effective alternative because it actually removes the contamination from the site.

Reduction of Toxicity, Mobility, or Volume Through Treatment:

This evaluation criterion addressed the degree to which the alternatives employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. Alternatives that do not employ treatment technologies do not reduce toxicity, mobility, or volume of COCs through treatment. The evaluation

considered the following specific factors:

- The treatment processes, the remedies that will be employed, and the materials that will be treated.
- The amount or volume of hazardous materials that will be destroyed or treated.
- The degree of expected reduction in toxicity, mobility, or volume, including how the principal threat is addressed through treatment.
- The degree to which the treatment will be irreversible.
- The type and quantity of treatment residuals that will remain following treatment.

There are no treatment RAAs for Site 1, therefore, none of the RAAs will reduce the toxicity, mobility, or volume of arsenic-contaminated soil through treatment.

Short-Term Effectiveness:

The short-term effectiveness of each alternative was evaluated relative to its effect on human health and the environment during implementation of the remedial action. Potential threats to human health and the environment associated with handling, treatment, or transportation of hazardous substances were considered. The short-term effectiveness assessment was based on four key factors:

- Short-term risks that might be posed to the community during implementation of an alternative.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.
- Time until remedial response objectives are achieved.

No additional risks to the community or workers will be incurred with RAA 1 because it includes no remedial action. RAA 2 may increase risks to the community and construction workers due to fugitive dust while installing the soil cover. RAA 2 will also result in a minimal increase in risk to workers during debris removal. RAA 3 will have similar risks to RAA 2 due to fugitive dust and debris removal. Additional risks to the community may also be incurred under RAA 3 because arsenic-contaminated waste will be transported off-site.

Implementability:

Implementability considerations included the technical and administrative feasibility of each alternative and the availability of various materials and services required for its implementation. The following factors were considered during the implementability analysis:

- *Technical Feasibility*: The relative ease of implementing or completing an action based on site-specific constraints, including the use of established technologies, such as:
  - Ability to construct the alternative as a whole (constructability).
  - Operational reliability or the ability of a technology to meet specified process efficiencies or performance goals.
  - Ability to undertake future remedial actions that may be required.
  - Ability to monitor the effectiveness of the remedy.
- *Administrative Feasibility*: The ability and time required to obtain any necessary approvals and permits from regulatory agencies.
- *Availability of Services and Materials*: The availability of the technologies, materials, or services required to implement an alternative, including:
  - Available capacity and location of needed treatment, storage, and disposal services.
  - Availability of necessary equipment, specialists, and provisions for necessary additional resources.
  - Timing of the availability of prospective technologies under consideration.
  - Availability of services and materials, plus the potential for obtaining bids that are competitive (this may be particularly important for innovative technologies).

RAA 1 (No Action) is the most implementable alternative because it requires that no remedial action be conducted at Site 1. RAA 2 (Soil Cover and Surface Debris Removal) and RAA 3 (Surface Debris Removal, Excavation with Off-Site Disposal, Soil Cover, and Institutional Controls) will require conventional and easily implementable construction equipment and technology. RAA 3 requires coordination with an off site disposal facility.

Cost:

For each remedial alternative, a detailed cost analysis was developed based on conceptual engineering and analyses. Unit prices were based on published construction cost data, quotes from vendors and contractors, and/or engineering judgment. Costs are expressed in terms of 1997 dollars. In order to allow the costs of remedial alternatives to be compared on the basis of a single figure, the NPW value of all capital and annual costs was determined for each alternative. The USEPA CERCLA RI/FS Guidance Document (USEPA. 1988) recommends that a 5 percent discount rate be used in present worth analyses.

In terms of NPW, the No Action Alternative (RAA 1) will be the least expensive ($0) alternative to implement, followed by RAA 2 ($245,000), and then RAA 3 ($270,000).

2.8.1.3 Modifying Criteria

State Acceptance:

The Commonwealth of Virginia was involved in the selection of the remedy for Site 1. Information regarding remedy selection was conveyed through Restoration Advisory Board (RAB) meetings, the FS Report, the WPNSTA Yorktown Partnering meetings, and at the public meeting held after issuance of the Proposed Plan. No Commonwealth comments were received disputing the final remedy. The Commonwealth is satisfied that the appropriate process was followed in evaluating the RAAs for Site 1 and concurs with the selected remedy.

Community Acceptance:

WPNSTA Yorktown solicited input from the public on the development of alternatives and on the alternatives identified in the Proposed Plan. A public meeting on the Proposed Plan was held on May 26, 1998. Community members of the Restoration Advisory Board (RAB) in attendance during the public meeting agreed with the selection of Alternative 3 at Site 1 as the preferred alternative. No additional information on the Proposed Plan has been requested and the 45-day public comment period closed on July 11, 1998, with no additional comments being received on the selection of a remedy.

2.8.2 Site 3 RAA Comparative Analysis

2.8.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

RAA 1 for Site 3, No Action, does not include measures to protect human health or the environment. RNA 2, Institutional Controls and Debris Removal, will prevent accidents from human interaction with debris piles. RAA 2 will also mitigate some potential risks to

human health by including land use controls that prohibit residential development and disturbance of the soil cover, but will do nothing to protect the environment. RAA 4 is very protective of human health and the environment because it includes removal and offsite disposal of the PAH-contaminated soil. RAA 3 would be the most protective because it actually treats the contaminated soil to reduce the PAH contamination to acceptable levels.

Compliance with ARARs:

Except for RAA 1 (No Action), the RAAs for Site 3 will comply with all applicable location- and action-specific ARARs as identified in Section 2.11.2 of this ROD. There are no chemical-specific ARARs for PAH-contaminated soil. A risk-based remediation level (RL) for the PAH contamination was developed that is protective of both human health and the environment.

2.8.2.2 Primary Balancing Criteria

Long-Term Effectiveness and Permanence:

The long-term effectiveness and permanence of the No Action alternative (RAA 1) are also unknown for Site 3. It is possible that the soil PAH concentrations can decrease through natural attenuation, but RAA 1 provides no means of monitoring PAH concentrations over time. RAA 2 (Institutional Controls and Debris Removal) also provides no remediation of the PAH-contaminated soil and, therefore, is not an effective or permanent solution to the soil contamination. RAA 3 (Soil Excavation with On-Site Treatment, Debris Removal, and Institutional Controls) will provide the most effective and permanent solution to the contamination at Site 3 because it actually treats the contaminated soil to reduce the PAH contamination. RAA 4 (Soil Excavation with Off-Site Disposal, Debris Removal, and Institutional Controls) will also provide an effective and permanent resolution to the PAH-contaminated soil at Site 3.

Reduction of Toxicity, Mobility, or Volume Through Treatment:

RAM 1, 2, and 4 provide no means of treating the PAH-contaminated soil at Site 3. RAA 3 satisfies the statutory preference for treatment. RAA 3 reduces the toxicity, mobility, and volume of contaminated soil through biological treatment.

Short-Term Effectiveness:

No additional risks to the community or workers will be incurred with RAA 1 because it includes no remedial action. RAAs 2, 3, and 4 may pose a limited risk to workers during debris removal activities. RAA 3 may increase risks to the community and construction workers due to fugitive dust while conducting excavation and biological treatment operations. RAA 4 will have fugitive dust concerns during excavation activities, and may also pose additional risks to the community because the waste is to be transported off-site.

Implementability:

RAA 1 (No Action) is the most easily implemented alternative because it requires no remedial action be conducted at Site 3. RAA 2 (Institutional Controls and Debris Removal) will be easily implemented. RAA 3 (Soil Excavation with On-Site Treatment, Debris Removal, and Institutional Controls) uses proven biological treatment and conventional construction methods. RAA 3 provides a permanent treatment solution, but the biological treatment is more labor and time intensive than RAA 4 (Soil Excavation with Off-Site Disposal, Debris Removal, and Institutional Controls). RAA 4 employs conventional construction methods and will be easier to implement than RAA 3.

Cost:

In terms of NPW, the No Action Alternative (Site 3 RAA 1) will be the least expensive alternative ($O) to implement, followed by Site 3 RAA 2 ($94,000), Site 3 RAA 4 ($155,000), and then Site 3 RAA 3 ($195,000).

2.8.2.3 Modifying Criteria

State Acceptance:

The Commonwealth of Virginia was involved in the selection of the remedy for Site 3. Information regarding remedy selection was conveyed through RAB meetings, the FS Report, the WPNSTA Yorktown Partnering meetings, and at the public meeting held after issuance of the Proposed Plan. No Commonwealth comments were received disputing the final remedy. The Commonwealth is satisfied that the appropriate process was followed in evaluating the RAAs for Site 3 and concurs with the selected remedy.

Community Acceptance:

WPNSTA Yorktown solicited input from the public on the development of alternatives and on the alternatives identified in the Proposed Plan. A public meeting on the Proposed Plan was held on May 26, 1998. Community members of the RAB in attendance during the public meeting agreed with the selection of Alternative 4 at Site 3 as the preferred alternative. No additional information on the Proposed Plan has been requested and the 45-day public comment period closed on July 11, 1998, with no additional comments being received on the selection of a remedy.

2.9 Selected Remedies

Based on an evaluation of the various RAAs developed for Sites 1 and 3, the DoN is selecting Site 1 RAA 3 (Surface Debris Removal, Excavation with Off-Site Disposal, Soil Cover, and Institutional Controls) and Site 3 RAA 4 (Soil Excavation with Off-Site Disposal, Debris Removal, and Institutional Controls) as the remedies for Operable Unit VIII at Site 1 and Operable Unit IX at Site 3, respectively. Under these RAAs, the hot spot

soil contamination at both sites will be removed and disposed off-site, the surface debris will be removed, the existing soil cover at Site 1 will be restored, and institutional controls will be implemented. **Figures 2-5** and **2-6** identify the major components of the selected remedies for Site 1 and Site 3, respectively.

The selected remedies will provide the best balance of tradeoffs among the alternatives with respect to the evaluation criteria. The DoN believes that the selected remedies will be protective of human health and the environment, will comply with ARARs, will be cost-effective, and will utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedies will not meet the statutory preference for treatment as a principal element.

Tables 2-23 and **2-24** present a summary of the cost estimates developed for Site 1 RAA 3 and Site 3 RAA 4, respectively.

2.10 Description of Selected Remedies and Performance Standards

2.10. Site 1

The selected remedy for Site 1 (RAA 3) involves the excavation and off-site disposal of contaminated soil with arsenic concentrations exceeding the RL of 63 mg/kg. The excavated soil will be tested to determine if it is hazardous by characteristic in accordance with the RCRA regulations at 40 C.F.R. Part 261, Subpart C. If the excavated soil is determined to be hazardous waste by characteristic, it will be stored on-site in accordance with 40 C.F.R. Part 264, Subpart I, prior to being transported to an off-site disposal facility permitted under RCRA, 42 U.S.C. § 6925, and in compliance with the RCRA regulations at 40 C.F.R. Part 264. The depth of the excavation shall be to a minimum of two feet; arsenic contamination is not believed to be deeper than two feet. A minimum of ten soil samples will be collected throughout the area of excavation during remediation to confirm concentrations in the underlying soil. Soil having exceedances of the RL for arsenic shall be removed and transported off-site to an approved disposal facility. The excavated area will be backfilled with clean fill from the WPNSTA's borrow pit, covered with six inches of topsoil, and revegetated with native grasses. Portions of the existing soil cover at Site 1 have eroded and/or have depressions. Under the selected remedy for Site 1, the existing soil cover will be restored with clean fill from the WPNSTA's borrow pit, covered with six inches of topsoil, and revegetated with native grasses. A topographic land survey will be conducted prior to the restoration of the soil cover to identify the depressions and eroded areas that need to be addressed. The surficial debris (miscellaneous metal and construction debris) identified within and around the Site 1 area will be removed and disposed and/or recycled as appropriate. Approximate locations of surficial debris are depicted on **Figure 2-5.** The current use of the Site 1 area is anticipated to remain as is; residential development of the area is not planned as per the Station's Master Plan. Currently, Site 1, an open field, is not used for any Station activities. Land use controls will be implemented to prohibit residential development at Site 1 and activities that interfere with or compromise the integrity of the soil cover at Site 1. Implementation of

TABLE 2-23

SUMMARY OF THE COST ESTIMATE FOR
SITE 1 RAA 3
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Cost Component	Approximate Subtotal Cost ($)	Total Cost ($)
DIRECT CAPITAL COSTS		
! General Pre- and Post-Construction Items	$80,000	
! Site Work	$15,000	
! Hot Spot Soil Excavation and Disposal	$24,000	
! Soil Cover Restoration	$30,000	
! Surface Debris Removal	$8,000	
TOTAL DIRECT CAPITAL COSTS		$157,000
INDIRECT CAPITAL COSTS		$33,000
TOTAL CAPITAL COSTS		$190,000
ANNUAL OPERATION AND MAINTENANCE COSTS		
! Soil Cover Maintenance		$5,500[(1)]
TOTAL NET PRESENT WORTH		$270,000

[(1)] The cost estimate for operation and maintenance is based on a 30 year period utilizing current values.

TABLE 2-24

SUMMARY OF THE COST ESTIMATE FOR
SITE 3 RAA 4
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

Cost Component	Approximate Subtotal Cost ($)	Total Cost ($)
DIRECT CAPITAL COSTS		
! General Pre- and Post-construction Items	$80,000	
! Site Work	$11,500	
! Hot Spot Soil Excavation and Disposal	$16,000	
! Surface Debris Removal	$20,000	
TOTAL DIRECT CAPITAL COSTS		$127,500
INDIRECT CAPITAL COSTS		$27,000
TOTAL CAPITAL COSTS		$154,500

Note:

No annual operations and maintenance costs are associated with this RAA, therefore, the net present worth is equal to the total capital cost.

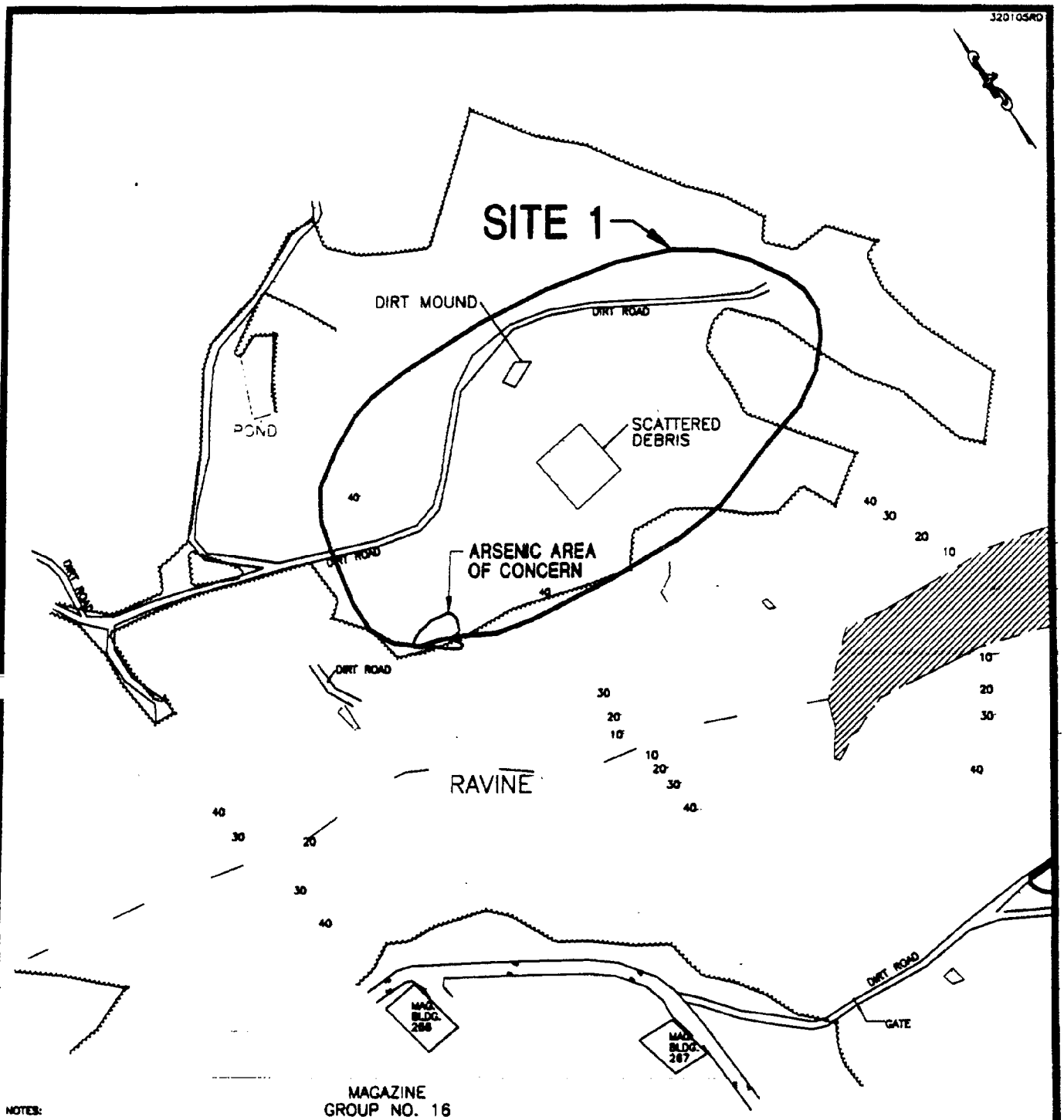


FIGURE 2-5
SITE 1 RAA 3: SOIL COVER, SURFACE DEBRIS REMOVAL, AND EXCAVATION WITH OFF-SITE DISPOSAL

NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

the land use controls is described in Section 2.10.3, below. Operation and maintenance consisting of soil cover maintenance will be conducted.

2.10.2 Site 3

The selected remedy for Site 3 (RAA 4) involves the excavation and off-site disposal of contaminated soil with total carcinogenic PAH concentrations exceeding the RL of 10 mg/kg. The excavated soil will be tested to determine if it is hazardous by characteristic in accordance with the RCRA regulations at 40 C.F.R. Part 261, Subpart C. If the excavated soil isdetermined to be hazardous waste by characteristic, it will be stored on-site in accordance with 40 C.F.R. Part 264, Subpart I, prior to being transported to an off-site disposal facility permitted under RCRA, 42 U.S.C. § 6925, and in compliance with the R-CRA regulations at 40 C.F.R. Part 264. The depth of the excavation shall be to a minimum of two feet; PAH contamination is not believed to be deeper than two feet. A minimum of six confirmatory soil samples wilt be collected throughout the area of excavation during remediation to confirm concentrations in the underlying soil. Soil having exceedances of the RL shall be removed and transported off-site to an approved disposal facility. The excavated area will be backfilled with on-Station fill, covered with six inches of topsoil, and vegetated with native grasses. The surficial debris (miscellaneous metal and construction debris) identified within and around the Site 3 area will be removed and disposed and/or recycled as appropriate. **Figure 2-6** presents the approximate locations of surficiat debris. The current use of the Site 3 area is anticipated to remain as is; residential development of the area is not planned as per the Station's Master Plan. Site 3, a wooded area, currently is not used for any Station activities. Land use controls will be implemented to prohibit residential development at Site 3 and activities that interfere with or compromise the integrity of the soil cover at Site 3. Implementation of the land use controls is described in Section 2.10.3, below.

2.10.3 Sites 1 and 3 - Institutional Controls

WPNSTA Yorktown shall prohibit (i) residential use of Sites 1 and 3, and (ii) activities that interfere with or compromise the integrity of the soil cover at Sites 1 and 3. These are the “land use control objectives” for Sites 1 and 3. The precise boundaries of the areas in which residential use is prohibited shall be fixed during the development of the Land Use Control Implementation Plan described in the next paragraph.

Within 90-days-following the execution of this ROD, WPNSTA Yorktown shall develop a Land Use Control Implementation Plan (LUCIP) with the concurrence of EPA Region III and in consultation with the Commonwealth of Virginia. The LUCIP shall include:

(1) a description and the location of Sites 1 and 3, including a map, a description of their approximate size, and a description of the contaminants of concern (COCs);

(2) the land use control (LUC) objectives selected above;

(3) the particular controls and mechanisms to achieve these objectives;

(4) a reference to this ROD; and

(5) any other pertinent information.

The DoN, with the concurrence of USEPA Region III and in consultation with the Commonwealth of Virginia, is developing a Land Use Control Assurance Plan (LUCAP) for WPNSTA Yorktown as required by the Record of Decision for Sites 6 and 7 at WPNSTA Yorktown, The completed LUCAP will contain Station-wide periodic inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Station personnel of any site specific LUCs deemed necessary for future protection of human health and the environment, including LUCs selected in this ROD. A fundamental premise underlying execution of the LUCAP is that through the DoN's substantial good-faith compliance with procedures called for therein, reasonable assurances will be provided to USEPA and the Commonwealth of Virginia as to the permanency of those remedies which include the use of specific LUCs.

Although the terms and conditions of the LUCAP will not be specifically incorporated in or made enforceable as to this or any other ROD, it is understood and agreed by the DoN, USEPA, and the Commonwealth of Virginia that the contemplated permanence of the remedy reflected herein shall be dependent upon the Station's good-faith compliance with specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the LUCAP be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

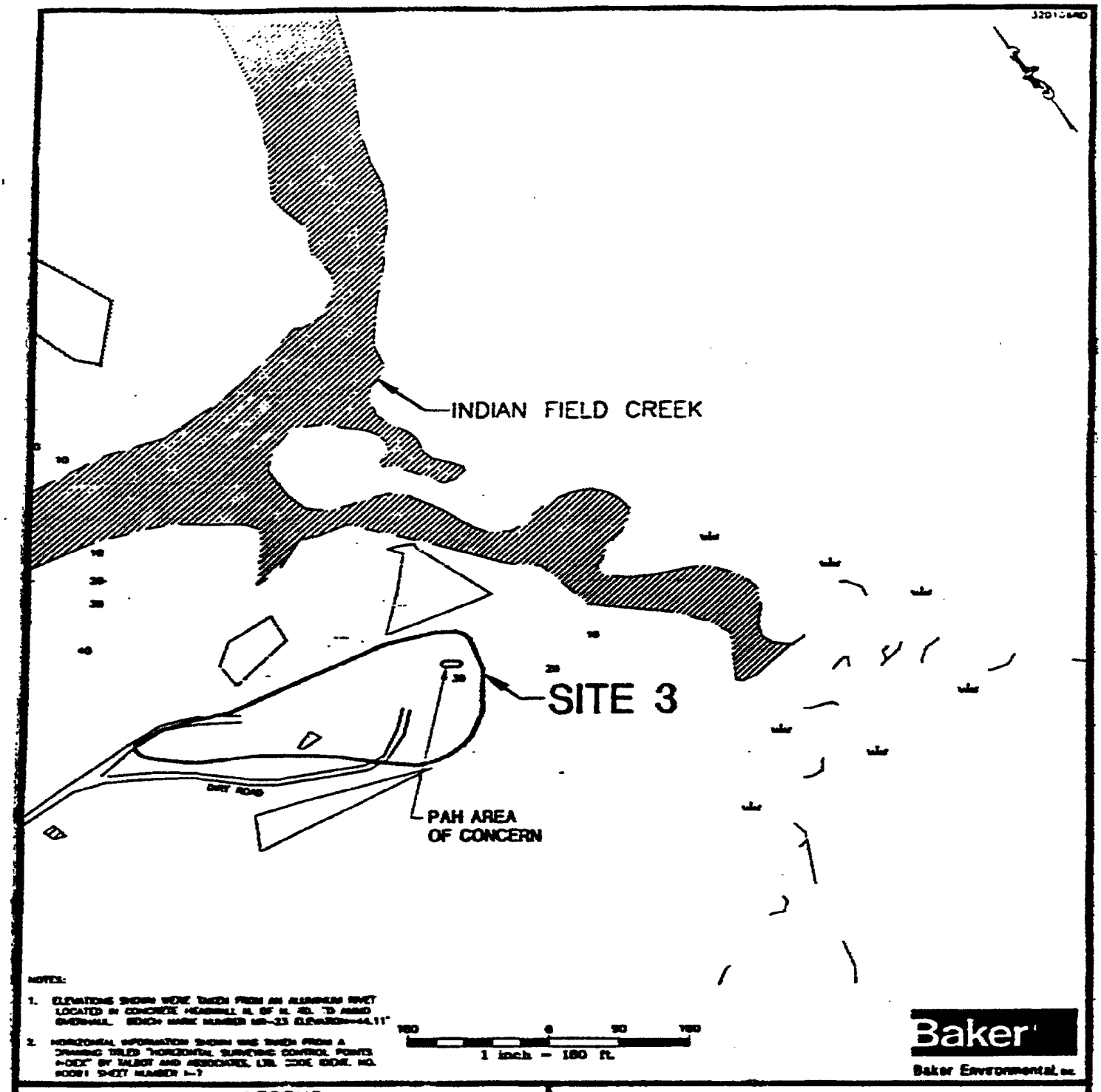


FIGURE 2-6
SITE 3 RAA 4: SOIL EXCAVATION WITH OFF-SITE DISPOSAL AND DEBRIS REMOVAL
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

2.11 Statutory Determinations

Remedial actions must meet the statutory requirements of Section 121 of CERCLA, 42 U.S.C. § 9621. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment; comply with ARARs of both Federal and State (Commonwealth) laws and regulations; be cost-effective; and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. Remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous substances, pollutants, or contaminants through treatment as the principal element are preferred. The following discussion summarizes the statutory requirements that are met by the RAAs selected for Sites 1 and 3.

2.11.1 Overall Protection of Human Health and the Environment

Site 1 RAA 3 and Site 3 RAA 4 will provide a significant reduction in risks to human health and the environment through the removal of the soil contaminants (arsenic and PAHs). As such, these RAAs will provide protectiveness to human health and the environment. The potential source of contamination to other environmental media will be removed.

2.11.2 Compliance with ARARs

The selected remedies for Sites 1 and 3 will comply with all Federal and State locationand action-specific ARARs as outlined below. Chemical-specific ARARs are not available for the contaminants of concern in the soil; therefore, a risk-based RL for PAH-contaminated soil was developed and the background level for arsenic-contaminated soil was selected as the remediation levels that are protective of both human health and the environment.

2.11.2.1 Location-Specific ARARs

- **Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470aa-mm) (32 CFR Part 229; 43 CFR Part 7)**

  Archaeological resources encountered during excavation must be reviewed by Federal and Commonwealth archaeologists to determine if such resources should be preserved. The WPNSTA Yorktown Environmental Directorate will be contacted and the Draft Historic Preservation Plan for WPNSTA Yorktown (U.S. Army Corps of Engineers, 1990) will be reviewed prior to development of the Remedial Action Work Plan to determine if archaeological resources are likely to be present at Sites 1 and 3.

! **National Historic Preservation Act (16 U.S.C. §§ 470-470x-6) (36 CFR Part 800)**

Impacts on properties listed on the National Register of Historic Places, or eligible for such listing, should be avoided or, if unavoidable, mitigated through design and data recovery. The WPNSTA Yorktown Environmental Directorate will be contacted and the Draft Historic Preservation Plan for WPNSTA Yorktown (U.S. Army Corps of Engineers, 1990) will be reviewed prior to development of the Remedial Action Work Plan to determine if such properties are present at Site 1 or Site 3.

! **Executive Order 11990, Protection of Wetlands (40 CFR Part 6, Appendix A, excluding Sections 6(a)(2), 6(a)(4), 6(a)(6), and 6(c); 40 CFR § 6.302(a))**

Requirement to minimize the destruction, loss, or degradation of wetlands that could be caused by a remedial action. Although no wetlands exist at Site 1 or Site 3, erosion from excavation activities could migrate to wetlands at Indian Field Creek. An erosion control plan will be established as part of the Remedial Action Work Plan.

! **Clean Water Act, Section 404 (33 U.S.C. § 1344) (40 CFR § 230.10; 40 CFR § 231 (231.1, 231.2, 231.7, 231.8))**

Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into a wetland without a permit. CERCLA on-site actions do not require a permit, but the substantive requirements of Section 404 regarding such a discharge are an ARAR. No material taken from either Site 1 or Site 3 will be discharged into wetlands.

! **Virginia Wetlands Regulation (VR 450-01-0051 §§ 1-5; 4 VAC 20-390-10 to -50)**

Regulates activities that impact wetlands. The remedial action will be undertaken in such a way as to limit potential impacts on wetlands via erosion from Site 1 and Site 3 during excavation activities.

2.11.2.2 Action-Specific ARARs

! **Resource Conservation and Recovery Act (RCRA), Subtitle C (Hazardous Waste Management) (42 U.S.C. §§ 6921-6939e**)

Applicable to any action at WPNSTA Yorktown involving treatment, storage, or disposal of hazardous waste.

- Identification and Listing of Hazardous Waste
(40 CFR Part 261)
Under RCRA, contaminated soils at Sites 1 and 3 are not considered hazardous by listing, but they may exhibit hazardous characteristics. Any wastes hazardous by characteristic must be identified as part of the remedial action in order to determine appropriate on-site storage procedures and to select an appropriate off-site disposal facility. If the waste is determined to be hazardous by characteristic, the off-site disposal facility must be permitted under RCRA, 42 U.S.C § 6925, and in compliance with the RCRA regulations at 40 C.F.R. Part 264.

- Use and Management of Containers
(40 CFR Part 264, Subpart I)
Regulates the use and management of containers of hazardous waste being stored at hazardous waste facilities. Remediation may generate containerized waste, such as investigation derived waste (IDW) associated with confirmatory sampling and the excavated soil. If this waste is determined to be hazardous waste under RCRA and is stored in containers before being disposed of off-site, the use and management of such containers stored on-site must be in compliance with 40 C.F.R Part 264, Subpart I.

! **Virginia Hazardous Waste Management Regulations (VR 672-10-1et seq; 9 VAC 20-60-10 et seq.)**

Regulates the treatment, storage, and disposal of hazardous waste.

- Identification and Listing of Hazardous Wastes (VR 672-10-1 §§ 3-3.12; 9 VAC 20-60-100 to - 220) Under the Virginia Hazardous Waste Management Regulations, contaminated soils at Sites 1 and 3 are not considered to be hazardous by listing, but they may exhibit hazardous characteristics. Any wastes hazardous by characteristic must be identified as part of the remedial action in order to determine appropriate on-site storage procedures and to select an appropriate off-site disposal facility. If the waste is determined to be hazardous by characteristic, the off-site disposal facility must be permitted and in compliance with all applicable requirements under the Virginia Hazardous Waste Management Regulations.

- Use and Management of Containers
(VR 672-10-1 § 10.8; 9 VAC 20-60-820)
Regulates the use and management of containers of hazardous waste being stored at hazardous waste facilities. Applies where the IDW associated with confirmatory sampling and the excavated soil is determined to be hazardous waste and is stored in containers on-site before being disposed

off-site.

- **Virginia Erosion and Sediment Control Regulations (VR 625-02-00 §§ 1-11; 4 VAC 50-30-1 - to - 110)**

  Applicable to remedial actions involving land disturbing activities. Activities associated with the excavation at Sites 1 and 3 will have an erosion control plan submitted to Atlantic Division, Naval Facilities Engineering Command (LANTDIV) for approval.

2.11.3 Cost Effectiveness

Site 1 RAA 3 is the most cost-effective alternative for Site 1 in terms of an "action" alternative. The other two RAAs developed and evaluated for the site do not include actions to remediate the arsenic hot spot.

Site 3 RAA 4 is the most cost-effective "action" alternative for Site 3. RAA 3 includes on-site treatment of the PAH-contaminated soil which is more expensive than the proposed remedy in RAA 4. RAA 3 would also take more time to implement which would increase labor costs.

2.11.4 Use of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedies for Sites 1 and 3 use permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedies require the removal and off-site disposal of contaminated soil, which is a permanent solution; however, the limited volume of soil that requires remediation at the sites does not justify the costs and other implementation factors associated with a treatment option.

2.11.5 Preference for Treatment as a Principal Element

The selected remedies for Sites 1 and 3 do not satisfy the preference for treatment as a principal element. Due to the limited volume of soil requiring remediation at both sites, the FS evaluated the off-site disposal RA.As as representing the best balance of all evaluation criteria, including cost.

2.12 Documentation of Significant Changes

The PRAP presented the selected remedies as the preferred alternatives for Sites 1 and 3. No significant changes to the remedies have been made since the time they were presented as the preferred alternatives in the PRAP.

3.0 RESPONSIVENESS SUMMARY

The final component of this Record of Decision is the Responsiveness Summary. The purpose of this section is to provide a summary of the public's comments, concerns, and questions regarding Sites 1 and 3.

During the public comment period, written comments, concerns, and questions were solicited. A public meeting was held on May 26, 1998, at the York County Recreational Services Building to formally present the PRAP and to answer questions and receive comments. The transcript of this meeting is presented in Appendix A of this ROD. All comments concerning the remedy have been considered by the DoN and USEPA in the selection of the remedial alternatives for Sites 1 and 3.

The Responsiveness Summary is divided into the following sections:

- **!** Overview
- **!** Background on community involvement
- **!** Summary of comments received during the public comment period

3.1 Overview

At the time of the public meeting on May 26, 1998, the DoN had endorsed a preferred alternative in the PRAP for the cleanup of arsenic-contaminated soil (hot spot) and the restoration of portions of the existing soil cover at Site 1 and for the cleanup of PAH-contaminated soil (hot spot) at Site 3 at WPNSTA Yorktown. The Site 1 alternative required excavation of arsenic-contaminated soil at concentrations above an RL of 63 mg/kg, and the restoration of portions of the existing soil cover at the site. The Site 3 alternative required excavation of PAH-contaminated soil at concentrations above the RL of 10 mg/kg total carcinogenic PAHs. The excavated soil from both sites would be transported off-site to an approved disposal facility. USEPA Region III and the Commonwealth of Virginia concurred with the preferred alternatives for both sites.

Based on the results of the public meeting (held on May 26, 1998) and associated comment period (held from May 26, 1998 to July 11, 1998), the community generally seems to be in support of the preferred alternatives.

3.2 Background on Community Involvement

Nearby communities have a good working relationship with WPNSTA Yorktown because the Station maintains a good neighbor policy through the Public Affairs Office. WPNSTA Yorktown participates in community events and celebrations to foster close ties with the community. As part of the ongoing Community Relations Program (CRP), community interviews were conducted in 1991 to inform the community of the IR Program and solicit

feedback on the listing of WPNSTA Yorktown as an NPL site. The community expressed concern about three issues: water resources, cleanup funding, and information availability/validity. This public openness has been maintained by the Public Affairs Office and the Environmental Directorate at WPNSTA Yorktown through the CRP and resulted in the formation of the Restoration Advisory Board (RAB). The WPNSTA RAB is comprised of agency representatives, technical and business persons, and members of the community at large. The RAB meets regularly, and progress at sites such as Sites 1 and 3 is discussed from the work plan stage to selection of the remedial alternative (if necessary). Preliminary RI results for Sites 1 and 3 were discussed at past and the most recent RAB meetings. No significant comments were received for either site at these meetings.

3.3 Summary of Comments Received During the Public Comment Period

The public comment period on the PRAP began on May 26, 1998, and ended on July 11, 1998. No comments were received from the public during the public comment period.

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CERTIFIED ORIGINAL

NAVAL WEAPONS STATION
YORKTOWN

PROPOSED REMEDIAL ACTION PLANS FOR
SITES 1 & 3 AND SITES 6 & 7

TRANSCRIPT OF PROCEEDINGS
Yorktown, Virginia
March 26, 1998

Appearances:
Jeff Harlow, Weapons Station Yorktown
Rich Hoff, Baker Environmental, Inc.
Scott Park, LANT Division
Bob Stroud, U.S. EPA, Region 3

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P R O C E E D I N G S

KAYE PHILLIPS: I'm Kaye Phillips, public affairs officer. I replaced Tom Black just about a year ago, and so it's nice seeing all of you here tonight. And captain - - I almost goofed there. Captain Denham is here with us. He's our commanding officer for the station. And Jay Dewing is our chairman for us - - cochairman.

Captain, did you have anything you wanted to say?

CAPTAIN DENHAM: No, I don't have anything. Go ahead.

KAYE PHILLIPS: Jay?

JAY DEWING: Not until later.

KAYE PHILLIPS: Okay. If any of you noticed in Sunday's paper, we had the ad that's running that's required for 45 days regarding this proposed remediation plan that's coming up for Sites 1 and 3 and 6 and 7. It started on the 26th of May. And the period will run from 10 July and any - - that's open for public comments. And all comments would be sent to my office, and then I turn it over to Jeff and these gentlemen that are working on this program.

Tonight, Jeff, along with - - we have Bob Stroud, who is new. I think it is his first official

meeting

BOB STROUD: Second

KAYE PHILLIPS: Okay. But Bob was still here the last time, right?

BOB STROUD: No, he wasn't here.

KAYE PHILLIPS: But Bob replaced Rob and he's here with us from EPA. And Scott Park and Rich will be working with Jeff in making his presentation tonight

If any of you know anyone in the community that has any comments or anything to make regarding these, my phone number is 887-4939. That's in the ad that's in the paper. And, please, feel free to call me, and we'll get the information for you that's desired.

So without anything further, I'm going to turn it over to Jeff. And I will mention that I think there's been some question about budget that wasn't on your agenda, but that will be covered before the close of the program this evening.

JEFF HARLOW: I guess first thing is we tried to incorporate this public meeting type scenario in with the RAB meeting. I'm interested in comments if you'd like to do this or we can take the technical stuff. I kind of thought this might be a quick way to

get up to speed to what's going on here in the next year or so at the station.

But, again, if we don't like this, we can change the format to just have a separate public meeting, just trying to save a little money and work it in. The trade-off of that is, is that, you know, we're sacrificing some of our RAB time for it. And then the other thing is we get in a pinch that we've scheduled so far ahead that when we announced the meeting, we were kind of set to do it; whereas in the past, we probably allowed for a couple of weeks for the announcement to hit the paper and then actually had the public presentation.

And I guess with that, what I'm going to do is we're going to do this as a joint effort like Kaye was saying. I'm going to let Bob pick up. He is new to the sites, but he's getting on board real quick and has been a big asset, as far as I'm concerned, and he's got the first four slides here for us to get us started, and then I'm going go into the site descriptions and then Scott and Rich will follow it up on the back end.

BOB STROUD: Good evening. I guess you-all know, my name is Bob Stroud. I'm the new EPA project manager for Yorktown. I've been involved with

the sites for about six months or so. My first meeting was in December of ‘97. What we want to try and do tonight is present to you the proposed remedial action plans for four different sites at Yorktown, Sites 1 and 3 and Sites 6 and 7. Actually, I’m probably going to be repeating what Jeff and Kaye just said.

Okay. This presentation to this meeting is to just let all concerned citizens know that Yorktown is going to be evaluating the four sites that I’ve mentioned, Sites 1 and 3 and 6 and 7. And as Kaye had mentioned to you, the public comment period begins today, May 26, and continues for 45 days, through July 10th, 1998. So if anyone has any comments, suggestions, or concerns, they can contact Kaye, I guess, by letter or phone or what have you.

This slide here just represents a couple - - actually, this is the entire facility. This map here represents the entire facility, with this being Felgates Creek in this area and this being Indian Field Creek. Sites 1 and 3 and 6 and 7 are in these two areas right here. I think the next slide shows it.

Here we are with Felgates, as I said, and Indian Field Creek here, Sites 6 and 7 and Sites 1 and

3. The reason that we're doing them together like this is because of their location. Since they are located so close to each either, it just makes sense in saving money and that sort of thing, to do these sites together.

With that, I'll turn it over to Jeff Harlow.

JEFF HARLOW: Okay. I get to do site description since I'm the resident expert, I guess. WE'll do Site 1 first. Ultimately it was a landfill at the station from 1965 through just beyond 1979. It operated under a conditional use permit. And a little note here for lens grinding dust, we have had a lieutenant command on our site, generally they make all the lenses - - or all the glassware for all the military. I think the Army closed their facilities down, and it's a pretty big business there.

But at one time they were dumping their lens grinding dust in our landfill, pretty much an inert plastic material.

This is Site 1 specifically, the entrance point down here in the bottom of the slide. Generally, all the debris is in this area here on the right-hand side of this access road that you see here. It's kind of a typical scenerio, I guess, for

landfills in the past. This was once a borrow area for sand and fill. They had a hole. What do you do with a hole? You fill it back in, and it became a landfill.

You see a small ponded area here. Word on it was it was an excavated area that just never got filled. It dries up in the summertime. And you see a green patch. It's kind of a little wildlife management area. It's beyond the boundaries of the landfill itself. Indian Field you're seeing here in the background right here.

Site 3 is a two-acre dump area, same thing. This one is even older than Dudley Road Landfill. It's been real difficult to even get - - except this document only speculates that it was used in the early 1900s as a fill area for us developing our industrial area. A lot of cuts, you know, steep walls and stuff where it just looks like they're in there mining out the fill for using somewhere else.

Ultimately the same thing cane down, you had a hole in the ground and what to do with it but try to fill it back in.

This is Site 3 looking at the main roads here. Putting some perspective, Dudley Road Landfill would be down here at the bottom. You can't see the

pointer very good down here. And the beginning of Indian Field Creek, or at least one of the branches, would kind of run between the two sites. And ultimately Indian Field would run down here at my feet or whatever. You're seeing some of our magazines here in the background.

Here's a perspective of the two sites together. Here you're seeing Dudley Road Landfill. And back in here you can kind of see some reduced growth. That's the landfill here. And then ultimately Felgates Creek coming out this way.

Site 6 - - and what we're doing - - I'm just going to back up here. We're actually incorporating both of these perhaps together in one presentation. So 1 and 3 is the first one. We're doing those two sites together as one unit. And ultimately you'll see a rod for those two sites.

And now for Sites 6 and 7, there will be a separate rod for that, and I just wanted to break that out so we can work it all in one presentation.

Site 6 is a washout facility, basically there since 1942-43. It's always been a reclaim facility for TNT. We did install a carbon absorption tower in 1975 which theoretically should have alleviated the waste that we would have been putting

in the creeks.

And then ultimately we hooked up HRSD, and we've been knocking this around. I have to do a little more research, but I thought it was the early ‘80s. We’re saying ‘86. That’s the best we have as of right now.

There’s also -- along with some of the cooperative efforts with EPA, they had some considerable concerns with the actual building itself being contaminated, potentially the contaminants migrating out into the facility. And so we’re also looking at some of the trenches and stuff inside the building. It won’t be a perfect clean closure of a building, but at least we’ll negate any potential for the building itself contaminating out in the environment.

We then in the future have schedules to do building demolition under the MIL COM program where it should appropriately be done.

This is building 109. You see here in the shadows a little bit, you see the trench here went out into, what we call now, the impoundment area. There’s a dam or what –- the impoundment here that you see. And you don’t see it on here, but it’s along this general area. And all of that wastewater

went out from this ditch into this marshy area.

There's another thing with this site off to the side here, there's an annex that had a vapor phase degreaser in there and some TCU problems here on the site along with some explosives. This was a second phase. I guess this building generally went through two improvements, I guess, or modifications. And this equipment went in the early ‘40s and then it went through an upgrade.

At one time there was a tank inside this building that actually they did TCE liquid solution and degreasing or actually tar removal of the lining material inside the bomb casings. And what I understood what they do is when it got dirty, you'd open up the valve and out in the creek it would go.

This is looking back towards Building 109, and you can now see the impoundment itself here It was also -- just to put a time line, it was built at the same time the building was built, in 1942.

As far as the whole area here -- and I guess Rich will get more into it, but the impoundment itself is not really showing any large amounts of explosive contamination. We're seeing it right at the edge of the trench, right at the end of it.

And, of course, in the proposal we're

going to look at just doing long-term monitoring to see where it's at instead of destroying the wetlands to see what might be out there.

Here you're seeing a view from the building and the trench here going out into the marsh. That concludes 6. And I'll go into 7.

Now, 7 was our actual explosive loading plant three. You had a loading facility. You load weapons or casings of bombs, and whatever you had at the end of the day, you'd have washdown procedures, whether it be the kettle or just the building itself. Before 1975, that wastewater went right directly into the creek.

After 1975 it, at least, went through carbon tower, and then ultimately we went to HRSD. All of these – and just to reiterate, all of these buildings for both 6 and 7 are since closed. 109 has been closed since the mid '80s. And plant two, I guess, closed about three years ago or two and a half years. And so that's where we're at on that.

This would be a view of plant three here. Just a quick overview, you had the prep building where your empty casing would come in. This was the actual loading facility here. You did remote loading. During the actual loading process, you'd be

in the bunkers and actually be loading remotely. And that discharge water came out the building right here. And you see like a – here it's hard to see; we'll get to a few slides down in the bottom of this presentation, but there's a run of rip rap here.

We did a removal action a couple of years ago, and that's the biocell or bioslurry job that we did. And I don't want to steal Rich's thunder here, but essentially we succeeded in doing a good treatability study so we don't have to go back out here and clean this thing up.

And with that -- who is it, Scott or Rich?

RICH HOFF: What we're going to do tonight is a much more linear presentation of the remedial action plan for these sites because of the number of sites we have. In the past we have come in here and we've discussed in detail the analytical data, the risk assessments, and the evaluation of all of the proposed remedial actions.

We thought in order to keep it a little shorter and open it up for questions, that we would run through this information in a little more streamline manner. That was based on comments we received from EPA Region 3. We've given these

presentations to their hierarchy. And one of their recommendations was to streamline the process and get more informpation out to you-all quicker.

I'm going to start with Sites 1 and 3. Scott will take 6 and 7.

As a recap, remedial investigations were performed at both Sites 1 and 3. That included both Round 1 RI and a Round 2 remedial investigation. Data that was collected during these investigations were compiled into a focused feasibility study.

We did a focused feasibility study rather than a full-blown feasibility study because the areas of contamination in both sites were rather small. In fact, the first time we did a proposed plan, we were suggesting no action at both sites.

But because of the partnering process that we're involved in, we've been able to sit down with the regulator and really dissect the information. And there were some concerns that came out of it, the least of which is not the state's concern about Site 1 and the fact that it was a solid waste limited landfill.

There were some findings that there were low-lying areas that needed to be filled in. And so when we went through the process, we wanted to focus

on those technologies that would supplement the reestablishment of the cupboard.

I also wanted to mention that EPA Region 3 is going to be doing a comprehensive surface water investigation at Indian Field Creek and Creek in the next few months. And because of the interconnectedness between groundwater and surface water in Indian Field Creek, we didn't want to evaluate any remedial alternatives at this time for those media. So this focused feasibility study really concentrated on the soils in both Site 1 and Site 3.

This is one of our worst figures. I apologize for the quality of it. But this is Site 1 and here's Site 3. You saw through the pictures that there was a ravine or a ditch that sort of bisected the two, and then you enter one of the branches, one of the two branches of Indian Field Creek on either side of Site 3.

To evaluate the human health and ecological risks, when we conducted the risk assessment, there were really no unacceptable risks. Current receptors, again no unacceptable risks. Because of the frequency of exposure, it's rather limited.

Future receptors. The concentrations

when averaged over a large area really didn't give us much of an average or an upper 95th percent that we would have to worry about. But there were some hot spots.

The terrestrial and aquatic receptors under the ecological risks is one of the few sites where we had no really significant ecological concerns.

When we were doing the focused FS, there were one or two locations around Site 1. In fact, they were well-boring locations that had high arsenic concentrations. And by "high," I mean they were above station-wide backdrops, which is about 63 parts per million.

And we did some additional system sampling to fighre out what the extent of this was, and we also tried to get to the bottom of why there might be this incrased arsenic concentration. But we never really figured out the latter, but we did take additional samples, quite a number of them, to define the hot spot. And we used 63 parts per million and above as a way of incoporating the hot spot and evaluating the extent of potential contamination.

And, again, the solid waste landfill cover will be reestablished as part of the remedy.

It's not really a risk-driven action, but, again, out there and we wanted to address it as part of the remedy.

At Site 3, again with current receptors, there were no unacceptable health risks. Future receptors, there were some unacceptable risks for adult and children. And this was based on another hot spot. And at Site 3 we had PAHs. And if you remember the site description for Site 3, you saw a lot of oils, greases, sludges, and solvents that went in there. And this is, in fact, what we're turning up; those PAHs are usually a constituent of those types of waste materials.

True to form, the terrestrial demonstrated a slight risk again to the PAHs. And the aquatic, with the limited data that we had on Indian Field Creek, there was no significant risk present. Again, I want to state that EPA is going to be collecting additional data, and that's one of the reasons we don't want to make any comments on the aquatic, Indian Field Creek, and the groundwater at this time.

This is, again, kind of difficult to see, but if you take a look at Site 1, we have an area of debris that we're going to pick up. This is the

extent of the arsenic hot spot. It's very small. And what's interesting is it's really off of the main of what was considered to be the solid waste landfill. So to my knowledge, we really have no idea as to why arsenic exists there. But sure enough when we take those samples, that area is well in excess of all the other areas at Site 1.

Site 3, again the same situation, where there are a number of debris piles that we have identified. This is what we consider the extent of Site 3 proper. And the small red area in the center is the area of soil that we're concerned about. This was identified and delineated using PAH test kits down to a depth of four feet, and we have a very good handle on the extent of contamination.

To wrap it up, we're proposing remedial action three, and there are a number of remedial actions proposed for each site, and I would encourage you-all to take a look at the total remedial action plan for the details associated with each one of the RAAs and the associated costs.

We're proposing at this point in time to reestablish the soil cupboard at Site 1, to do the debris removal, and to do the soil excavation and off-site disposal in the area of the arsenic hot

spot. One of the reasons this was a focused FS is that with such a small volume, it really doesn't make sense to develop techniques such as in situ vitrification or any of the in situ technology that might be out there. It really wouldn't be cost effective.

Site 3 we selected RAA-4, and it's very similar. We're going to remove the debris that exists in the are and we're going to excavate the PAH hot spot. And, again, because of the limited size, we're going to off-site disposal. And this will be disposed of an nonhazardous. We have to do TCLP to confirm that. But, again, you're talking about such a small area that it really doesn't make sense to look at any land finding or compost technologies. And the present work for this remedial action, the alternative is 155,000.

With that, I'd like to turn to Scott and he'll tell you a little bit about 6 and 7.

SCOTT PARK: Okay. Moving over to Sites 6 and 7. Again, like Sites 1 and 3, we conducted remedial investigations and post RI investigations at each of those sites. And then a feasibility study report evaluated the data collected from those investigations and also took a look at our remedial

action alternatives.

Again, we screened many and broke it down to about six or seven, and I'll present to you which one we came up with as our selection and that we're proposing, again in the proposed remedial action plan that you can review.

Sites 6 and 7 the -- let's see. Operable Unit 14 is the whole area that bounds-- runs along Felgates Creek. Site 6 is generally in this area. That's the building Jeff showed you. Here's the drainage way from that building and the large impoundment that he showed to you. Site 7 is down here. And you'll get some site pictures of those.

Site 7 is Operable Unit 12. And Operable Unit 13 is the flume area or drainage way leading from Building 109 out towards the surface impoundment. And then Operable Unit 15 is an excavated area. I'll talk about that a little bit more and why it's there, what we're doing with it.

Based on risks assessment summaries, conclusions from Sites 6 first were unacceptable risks to human health from future residential exposure to the soil and sediment in the impoundment area. Highly unlikely that it will be developed for future residential, but the possibility, I guess, does exit

and there are some risks to doing that.

Unacceptable ecological risks to receptors in the impoundment area, the flume area, and the excavation areas, those are called areas of concern. But actually the flume area is AOC, or Area of Concern 1, the impoundment area is Area of Concern 2, and the excavation area is Area of Concern 3. You'll see a picture of all of those.

Site 7 conclusions were there were no unacceptable risks to human receptors under any land-use scenario, no unacceptable ecological risks, and all the risks were mitigated by the removal action conducted for the full-scale pilot study. Jeff talked about that.

Soil was removed and was taken to our biotreatment cell were it was put into a slurry using the simplex saber technology, and that's been cleaned up. And we're also using that cell right now to clean up Site 19 which is another site we have evaluated and moved to Rodham (phonetic).

This is a picture of Site 7. I'll cover that first since it was basically taken care of already. This is the area of concern that was cleaned up. This is a little before my time. These guys can help me out. I believe this material here is gravel

that was placed down after the excavation took place just to show a level where we had excavated to if it ever came back later and somebody had to go back down, they would know the area that had been taken care of.

This is just a grading of that area and regrading it, and it wasn't revegetated, but it is starting to vegetate itself, I believe. It's a low spot down by site 7.

Areas of Concern 1 and 2. First, again the building is down in this area and there's the drainage way coming out of the building that leads out towards the impoundment. There's a concrete channel -- a system of channels underneath the building and then a channel that leads wastewater out into the flume area, as we call it, and then further along into Area of Concern 2, which is right here. That's the impoundment area.

As Jeff mentioned, most of the contamination that was found that had risks associated with it was right in this area, Area of Concern 1. And that's the area that we're focusing our actual cleanup, if you will, as I'll tell you about in our remedial action alternative.

This is AOC-3. It's an excavated area, very uniform and rectangular as you can see. We're

not really sure where that came from. We don't know if it's a basement for a house or a building or a borrow area. I don't think it's a house, but it looks more like something like a borrow area or something somebody was getting ready to construct and they never did. And it's just an area that's there, and actually we're just going to fill that in and cover it. And we haven't found any risks associated with that.

The selected remedial alternative for Sites 6 and 7. Sites 6, again, many were considered. We're proposing in situ biological treatment using a different biological treatment than the Simplot process.

In our last meeting we discussed a joint venture we're working on with W.R. Grace and the Canadian government, and we're looking for split funding from both of those two entities, and the Navy; the three of us are going to share-cost that. We're in the treatability study phase right now, and it's going well. If we have full proof that the technology works, that's what we're proposing to use. It will be a land farming treatment on the station and it will be in a greenhouse type of structure.

And we'll clean up about a thousand cubic yards of material, is what we're expecting right now.

That's from our Area of Concern 1. There will be a soil cover area in Area of Concern 3 which was excavated, that we're not quite sure where that hole came from.

Also as part of the project, we're going to do sludge removal from the channel system underneath the building and the channel running out to Area of Concern 1. And that will remove all the contaminants and residual contaminants from operations in that building so we can then block off the channel from the building out to our site. And that way in the future if any water were to get in the building or anything came out from those channels, it would be clean because we had already taken care of it; we wouldn't recontaminate our site.

Then we'll do long-term monitoring of surface water and groundwater in the entire area. And, again, Jeff had said the Area of Concern 1 was our primary area of contamination, and it didn't seem it was getting into the surface impoundment. And we're going to do long-term monitoring of the surface water and groundwater to make sure that there's nothing going on. The net present worth is about $673,000.

And then Site 7, there's no action

alternative because the site has actually been cleaned up under a pilot study. And that present worth is obviously zero.

Just to move along to the public participation. Our public comment period began today in the newspaper in The Daily Press. Kaye talked about that. And the purpose is to encourage you and other members of the public to participate in that process and the selection of the proposed alternatives for all four of these sites.

The comment period will close on July 10th of 1998. It's a 45-day comment period. We look forward to hearing your comments today and by mail or by phone call if you should choose to do that.

And on that, we'll go to comments, questions, concerns, open the floor up to anything anybody would like to talk about on these sites.

CINDY BARBRAU: Cindy Barbrau, York County Business. You said that Site 7 was done under a pilot study. Do you have anything about approximately how much that --

SCOTT PARK: The cost of it?

CINDY BARBRAU: Yeah.

JEFF HARLOW: It was a large-scale pilot study

RICH HOFF: It was about a million dollars.

SCOTT PARK: Did that include the construction of the cell?

RICH HOFF: Yeah. That included the construction of the biocell area, the excavation of of the area which expanded in scope once we started into the digging, which, I think, a lot of these areas will probably grow past the data that we now have. The nice thing about that is that although we did spend a million dollars in the up-front, we are starting to see some returns from the presence of the biocell, and it's greatly cheapened the remedial action for Site 19.

SCOTT PARK: The capital cost will be recouped every time we use that cell, so it will be recovered.

JEFF HARLOW: I guess the fortunate thing or the unfortunate thing, however you look at it, Grace came into play in the middle of all of this and now we're looking at another alternative, innovative technology, to treat contaminated soils, along with TCE.

The original plans of the cell was to, you know, not only clean up Site 7 and 19, but we also

intend to use it for Site 6. So my guess is that in hindsight, we should have better planned ourself, but it was an unforeseen planning.

SCOTT PARK: Well, also Site 6 has volatile contamination which Simplot Technology would not cover and Grace would, so we're hoping that's going to prove itself useful for not only the explosives but the volatiles.

CINDY BARBRAU: That was a joint venture?

SCOTT PARK: That's right.

CINDY BARBRAU: Have they done something similar up in Canada?

SCOTT PARK: No, but the way that works is Industry Canada has a program that's part of –- it would be like our Department of Commerce. They have a program where if people can put in -- demonstrate a technology or product or anything that they think will create jobs in Canada, W.R. Grace and U.S. corporations will have a major lab, and a lot of their works goes through environmental –- it goes through the Canadian lab.

The inventor of the process runs that lab. And so if they can market this technology -- they have demonstrated it on pesticides and some other

compounds, but if they can demonstrate it for explosives and volatiles and then they can market that technology, it will provide jobs in Canada due to all of the associated items that go into the lab work and the analytical work.

So the Canadian government is willing to market that or make it succeed so then Grace can market it because it brings jobs into Canada, and Grace wants to do it because it will make their product and service marketable. And we're interested because they are willing to pay a fair share to help us do it, and so it makes our project highly amenable and cost effective.

JEFF HARLOW: Anything else? Let's go ahead and take a five, ten-minute break and get set up for the next presentation.

SCOTT PARK: And give you time to of more questions.

(Public Hearing concluded at 7:10 p.m.)

COURT REPORTER'S CERTIFICATE

I, SCOTT D. GREGG, RPR, and Notary Public, certify that I recorded verbatim by Stenotype the proceedings in the captioned cause before a public hearing, Proposed Remedial Action Plans for Sites 1 & 3 and Sites 6 & 7, Yorktown, Virginia, on May 26, 1998.

I further certify that to the best of my knowledge and belief, the foregoing transcript constitutes a true and correct transcript of the said proceedings.

Given under my hand this 10th day of June, 1998, at Norfolk, Virginia.

Scott D. Gregg

Scott D. Gregg

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